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DISCOVERY

A Monthly Popular Journal of Knowledge

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SIX-SWEEP MILL, NEAR LEWES, SUSSEX

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Editorial Notes

YOU can get an influential body of public opinion to support the cause of game preservation in darkest Africa. The Wembley Rodeo had its embattled and embittered partisans and opponents, but under your very eyes and noses you allow the native fish life of your own country to be poisoned.

* * * * *

The public know vaguely that there has been some talk about tar poisoning the fish, and that there is a Parliamentary Committee or some such body sitting. Neither of these facts are accurate. Firstly, the trouble is not mainly caused by tarred roads. Secondly, the body concerned is the Standing Committee of Rivers Pollution of the Ministry of Agriculture and Fisheries. Lastly, the public are all too prone to consider the affair simply a fuss between anglers and various nebulous interests who appear to have a vested right to pour poison into our English rivers.

* * * * *

Actually it is not simply a matter for anglers, but one of considerable importance to every class in the community. A century ago there was hardly a polluted river in the country. With the development of industrialism, manufacturers and local sanitary authorities began to make increasing use of the rivers, not as rivers, but as sewers. There was no effective legislation to check the increase of the evil and any kind of filth and liquid refuse - chemical or otherwise—was simply poured straight into the natural stream, In 1861 an Act was passed inflicting mild penalties for polluting waters *containing salmon.* It was, however, so hedged round with pretexts affording the poisoner every avenue of legal escape, that it was very little practical use. It did not cover other fish.

* * * * *

The new Salmon and Freshwater Fisheries Act 1923, which became law and operative on 1st January, is a far better measure for it protects all fish, spawning grounds, spawn and food of fish. This last is a sound biological clause on which a very great deal depends.

* * * * *

Proceedings under the new act can, however, only be instituted by a fishery board or by an individual who is certified by the Ministry as having a material interest in the waters alleged to be affected.

* * * * *

The policy of the Commission has been the very sound one of mutual co-operation between industrial and fishery interests. They have used persuasion, and have induced local authorities to improve their sanitary measures and manufacturers to render their waste products harmless, before discharging them into the streams.

* * * * *

This good beginning is promising, but as all reform is dependent on a vigorous and informed body of public opinion supporting the remedial measures, it is important that people other than anglers take an active interest in supporting the efforts of fishery boards. The question is one which is important to the naturalist, the nature lover, the sociologist, and anyone interested in questions affecting the health and well-being of the community at large.

* * * * *

The angler is not simply a wealthy individual with a mile or so of trout water. There are probably well

over half a million anglers in the country, and the great majority are working men. It is one of the best, healthiest and soundest of sporting recreations available to them. The battle for the rivers is definitely one in the interests of all classes of the community, and in the interests of coarse no less than game fish.

* * * * *

The first report of the Standing Committee on Rivers Pollution (Stationery Office, 3*d.* net), gives a very valuable account of what has been done to date. The investigations show how pollutions may be broadly separated into two groups. Firstly, sewage effluents—a matter whose degree of toxicity can be controlled by the local sanitary authorities; secondly, chemical or manufacturing wastes from factories. The most important work is being done in not only finding out what is the particular source of poison in given cases, but also what practical and economical measures can be taken by the offending manufacturer to render his wastes harmless.

* * * * *

At the moment heavily polluted rivers can barely be dealt with, but, thank goodness, no new pollutions can be legally instituted in hitherto unpolluted streams.

* * * * *

Fortunately for us, the foulness of our ruined waters is not a lasting condition. They can easily be restocked when once again they are fit to support fish life and nature has a chance to reassert herself. Wherever there are flowing streams, rivers or even big lakes and ponds, there should be fish. If there are none, it is only because we are allowing them to be poisoned. Public opinion must be roused to the point where it recognises that a polluted river is a disgrace to the community. Sources of pollution must be scientifically traced out by careful observers, and the influence of public opinion invoked to press the offending factory to reform its ways.

* * * * *

It is more than probable that when the Standing Committee (which is at present hampered by lack of adequate grants) has its biological side more fully developed, the co-operation of readers of DISCOVERY will be invited and water reports will be welcomed.

* * * * *

Some interesting problems arise. The food material of adult fishes is fairly well known, but the natural food of fry is mainly small water life and not so well known. The chain can well be carried a link further. What is the food of the plankton and minute crustacea on which the small fish live? What particular rotifers or infusoria, plant life or conditions are best for encouraging the growth of fish food and thus fish?

* * * * *

This is a holiday number of DISCOVERY. It is perhaps rather unorthodox for a serious journal to sink to such a popular device. But there is a reason for it. Many readers will be at the seaside, and with their families. Hence the fascinating article on the early life of baby herrings. Others will doubtless come into contact with the irrepressible harvest bug and minor irritants of the country-side. Knowledge may not allay the irritation, but it is at least something gained. Other articles range from The Story of Mars to "Greenland's icy mountains"—a splendidly cooling topic if August is a real holiday month.

* * * * *

Those of you who are near Folkestone may be reminded that the excavations at the Roman villa, on which we had a short article last month, will be resumed under the direction of Mr. S. E. Winbolt. It is seldom that exploratory excavation takes place in such a crowded centre, and thousands who have read of discoveries may have an opportunity of actually witnessing the slow uncovering of a find.

* * * * *

Again let me ask you to do a little missionary work for DISCOVERY. You will meet people on your holiday who do not know the paper, but who will like it when it is brought to their notice. We will send a free specimen copy to anybody who sends in a postcard, or to any individuals whose names and addresses you are good enough to send us.

KELVIN CELEBRATION.

A NUMBER of instruments and apparatus which are closely related to Lord Kelvin and his work are preserved in the Science Museum at South Kensington, and on the occasion of the Kelvin Centenary, which is being celebrated this week, these have been brought together in one of the galleries on the first floor of the new Museum building. They include one of the early siphon telegraph recorders designed by Lord Kelvin, his marine mirror galvanometer of 1858, one of the first mirror galvanometers for use with submarine cables.

The first and second model of his tide-predicting machine are also shown, as well as the machine in its final form as made for use. Examples of his magnetic compass and binnacles with corrector; a deep-sea sounding machine, and several other objects of historical and scientific interest are also on view. They will remain on exhibition until the end of the summer.

The Avocet at Home

By E. L. Turner (Hon. M.B.O.U.).

Readers of DISCOVERY *will welcome this and subsequent delightful articles on Bird Life by Miss Turner, who is now at Scolt Head in Norfolk, acting as bird-watcher on the breeding reserve.*

No one can do justice to the charm of the Avocet (*Recurvirestra avosetta*), or adequately describe the beauty and grace of its varying attitudes. It is a creature of emotions—easily roused to anger, but on the whole sociable and confiding. As, however, most of my observations were made in a protected area, the subjects of these notes had little cause for fear.

Anger is expressed in two ways. If the Avocet when paddling about in the water suspects you of designs upon its nest, it lowers its head and rushes towards you with expanded wings, swaying to and fro, so that first one wing and then the other just touches the water. The bird may then rise and fly straight at you, but, as a rule, it retreats with the same swaying movements, apparently with intent to lure you from the nest. Sometimes it will paddle round almost at your feet, floundering and struggling in the water, feigning injury. The same manœuvres are carried out on dry land, but then the bird puts even more energy into its attempts to distract your attention.

Valiant Defence

The Avocet's second method of attack is suddenly to fly at you with tremendous speed, hurling itself through the air, banking steeply, with its wings almost vertical and its long legs hanging down, while the head is held lower than the shoulders and the curved bill points aggressively upwards. This steel-blue scimitar would be a dangerous weapon if it were not so slender and flexible. The Avocet's bill always reminds me of Saladin's magic sword—"A curved and narrow blade which glittered not like the swords of the Franks, but was, on the contrary, of a dull blue colour, marked with ten millions of meandering lines which showed how anxiously the metal had been welded by the armourer."

This weapon may be useful to the Avocet when fighting with his kind; but he knows that it is useless against the arch-enemy—man. So, at the last moment when the bird is within a few inches of your head, it sheers off, describes a wide circle, and returns to the attack. This manœuvre may be repeated several times; but if such a valiant display of courage fails to move you, the Avocet falls to the ground, spreads itself out flat with extended quivering wings, and writhes as if in agony. Meanwhile the air is rent with wild cries.

If an Avocet's anger is directed against another bird, a fierce fight often ensues, for it is decidedly pugnacious at times. Terns and Black-headed Gulls were often subjected to attacks. In fact, the irascible Avocets were constantly picking quarrels with the Terns, amongst which they nested. Their movements are so sudden and swift that when fighting amongst themselves or with other birds, they appear to be an indistinguishable mass of feathers. I could not see whether the Avocet uses its bill or its feet in the attack; but from the angle of flight and the way in which the head is lowered, possibly they let drive with the full force of their shoulders.

Avocets' Club

The Avocet is a sociable bird, frequently nesting in colonies, or amongst other waders. It is decidedly interesting and amusing when nesting with its congeners, as its social qualities can then have full play; moreover, it is not always quarrelling. When the females are brooding, the males who are off duty form a kind of club in the shallows. They stand in little groups and all talk at once, thus making a continuous chattering noise. A great deal of bowing and posing, and running round each other takes place, and a variety of beautiful attitudes are assumed. In fact, the Avocet is almost as self-conscious as the Ruff, and these social gatherings seemed mere occasions for a display akin to that of the Ruff. They begin peacefully, but often end in squabbles; sometimes only two birds disagree, but occasionally there is a free fight. In a dull suffused light these gatherings of Avocets are specially beautiful. The tall birds with their long shadows reflected in the water make a wonderful picture. There is a quaint solemnity about their attitudes and general proceedings to start with, but when they get convivial the spell is broken; the shadows become distorted owing to rapid changes of position and the silver mirror is soon dulled with the scurrying of many feet.

On the whole, a colony of Avocets is fairly quiet when undisturbed, though the air is full of subdued sound. They pay no attention to the men who are working on the land adjoining their nesting area, but

the appearance of a stranger is the signal for a great uproar. The colony rises in a mass, together with the Terns, and a loud clamour ensues; if, however, you efface yourself, the angry tumult ceases, the birds soon settle down, and nothing is heard but the soft murmuring of many voices.

The Avocet's call-note is a flute-like "kluit, kluit," capable of varying modulations, and increasing in

CALLING THE NEWLY-HATCHED CHICK TO FOLLOW.

volume as danger threatens. The Dutch name for the Avocet is "Kluit," so named from this its ordinary call-note. When fifty or sixty birds are all shouting together the note sounds strident, but when whispered to the young, it is the softest possible music; you can hear the old birds crooning to the newly-hatched nestlings, as they cover them in sheltered nooks. Another note, which seems to be a warning call to the young, is a reedy "koek, koek." The Avocet also makes a curious moaning sound akin to that of the Eider Drake. This note evidently expresses happiness and contentment. The memory of it recalls visions of stately Avocets standing at ease in sunlit pools, while the young ones play around.

When feeding, the Avocet prefers water that is only four or five inches deep. There is something about their long swinging stride and rapid rhythmic movements that reminds one of men mowing. The body is bent downwards, the bill sweeps the water from side to side, keeping time with each stride; in this manner they scoop up minute crustacea, aquatic insects and larvae, besides a certain amount of algae.

My first introduction to the Avocet colony was on May 17th, 1920; the birds were then brooding, though a few nests contained eggs which were chipping. We had passed several pairs nesting on the meadows, but my host hurried us on, cheering us with promises of a treat in store. I shall never forget the thrill of delight we experienced when a turn in the path suddenly revealed this hidden colony. The Avocets rose in a mass as we approached, and at once proceeded to attack us. I, who had never seen one before that day, suddenly found myself surrounded by these wonderful birds. My companion, after some moments of breathless silence, remarked in ecstacy: "I don't care if I die now; I never guessed it would be like this!" Terns added their cries to the general uproar.

Intruders.

Godwits screamed, and fussy little Kentish Plover scurried over the mud. A solemn group of Oystercatchers, about fifty in number, remained silent and motionless; it was the hour of their evening meditations. These wary old birds eyed us with alert intelligence, but maintained a dignified and noncommittal attitude.

The next day I took my first photographs of Avocets; it rained all the time, and the results were poor; it was, however, an intense satisfaction to me just to sit and watch the birds. I had the whole colony under observation, and my own bird in particular; for some minutes she stood near the nest, a beautiful picture of indecision, perfect in outline and exquisite

CHICK AVOCET HATCHING OUT.

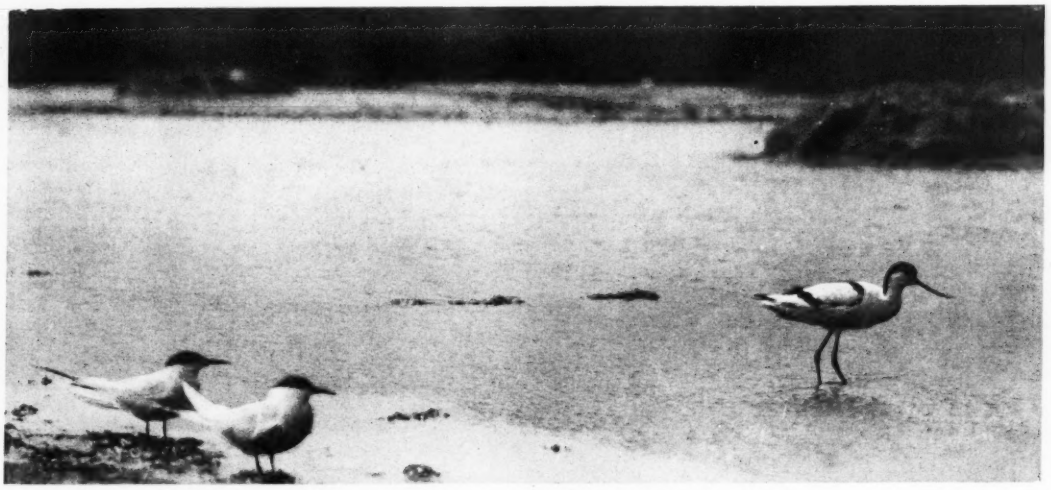
in her dazzling white and black plumage. Now and again she lifted one slender steel-blue leg and held it flexed; after a few seconds this foot was firmly planted a little in advance of the other; so by very slow steps she drew nearer. Her mate disapproved of this loitering and ran to and fro along a bank, with outstretched wings and a truculent air; finally, he

drove her to the nest. She moved away a few feet at the click of the shutter, but after the first surprise nothing alarmed her. Rain fell heavily, and the wind rose—a combination of circumstances which induced the Avocet to sit tight. As both sexes incubate, I waited on, hoping to see the birds change places, but in this I was disappointed. The male in his eagerness to brood is said gently to insert his long curved bill beneath the female's body if she refuses to move.

The Nursery.

It was a week before I could visit this colony again; by that time most of the Avocets had hatched off their broods, except those which were nesting on inaccessible islets with the Terns. The whole scene was changed. Numbers of small leggy chicks, in plumage resembling young Nightjars, were running about in the water. At first the young birds peck food directly from the ooze. The bill is short and almost straight, but there is a slight upward curve. As this seems to be a disputed point, I can only quote from my notes made on the spot. "Long, steel-blue legs, slightly upcurved bill, with the egg-tooth still adhering." I don't think I could have been mistaken when the subject of this note was lying in the nest drying in the sun, within four feet of my tent.

After a week or so the young Avocet begins to practise scooping up his food. From the earliest stages they peck right and left, and seldom straight ahead; there is always, too, the swinging movement so characteristic of the adult. The young Avocets are the most delightfully independent youngsters and wander over a wide area in search of food. The parents mount guard at either end of a given area and allow the chicks a considerable amount of latitude, but if there is cause for alarm, a sudden call from either of the old birds is promptly obeyed by the scattered brood; they either run to their parents or else make for the nearest cover. Like most young things, they prefer the companionship of their contemporaries. Occasionally a jealous parent suddenly dashes into the midst of a group of young Avocets and ruthlessly drives away any aliens. Either the Avocet's bill is not a very formidable weapon, or the young birds must be very tough. These attacks were often of a very vindictive nature, and I expected to see a little victim done to death; but after a severe drubbing, the babe, though apparently half-drowned, gets up and runs away. These attacks on the young are revenged by the parents, and especially by the male, so that a fight generally ensues. Numbers of young do die, but whether as a result of this treatment I cannot say; but they get trampled on a good deal during these skirmishes between the adult birds.



AVOCET WADING. TERNS ON FORESHORE.

The young leave the nest as soon as they are hatched, and many parents took their broods to the little drains which intersected the fields adjoining their nesting area; these drains are only one spit deep and just the width of a spade. Here the newly-hatched broods find food, and shelter from the cold winds. One parent mounts guard alongside, while the other crouches over the young in the drain. Sometimes the little ones all stand beneath the old bird; she does not thus actually cover them, but often they were completely covered for hours. In a day or two, however, the nestlings are strong enough to face the world and form gay little family parties.

I had occasion to pitch a tent near a drain in which Avocets were hiding their young. The old birds attacked the tent in their usual manner, but, finding it unresponsive, they then ran round it, posturing in an absurd way and screaming loudly all the time. They repeated this behaviour at intervals all one day, but eventually left the tent alone.

Early Days.

Avocets are fairly well distributed over Texel wherever there is suitable nesting ground. On May 25th I stumbled across an isolated nest in a meadow. The young were just hatching; two had left the eggs and one was emerging. I hastily put up a tent and had just time to get three photographs. The young birds soon became lively. At first they were content to shelter beneath the old bird, and merely poked their heads up through her plumage, after the manner of young Grebes. Fifty yards away another Avocet was crouching in a tussock of thrift, with a brood of three chicks, hatched that morning. These youngsters were "feeling their feet" and revelling in a new and sunny world. A clean sandy track ran from the nest I was watching to the spot where this other group was playing. After a time, my bird walked off her nest, wandered sedately along the sandy path and squatted beside the one sitting in the tussock. Then she called, and her eldest chick ran out of the nest and joined her. Seeing the other three babes, he soon made friends with them and played with them. His mother, however, returned to her nest after a short absence, looked round and called to her first-born; but he found his companions more congenial society and paid no attention to her cries. In this instance the parents of the three chicks were quite friendly and did not attempt to ill-treat the intruder. When my bird had successfully hatched out her brood she led them away, collected the truant, and wandered to the edge of a dyke. She then flew across the dyke, calling loudly to the little ones. They—although one was barely an hour old—plunged unhesitatingly into the water, where they swam about in rather a distracted manner. The old bird leant over the bank and encouraged them with softly uttered "kluits" and "koeks," until they plucked up sufficient courage to climb the steep sides of the dyke. Then I lost sight of them, for they were immediately joined by the male and wandered away into the rough pastures. While this Avocet was brooding, a Black Tern came flying low over the nest—not with any evil intent; she sprang at him, jumping straight from the ground into the air, about two feet. The male Avocet is very attentive to his mate and jealously guards the nest and young. He does most of the fighting, though both birds drive at any human intruder. I think it is the males only who meet in little companies to chatter and show off and fight.

Sentry-go.

Early in June I marked down an easily accessible family, which looked as if it could be photographed without much trouble, and such would have been the case, but for the male. Their feeding area was close to a spit of mud, just about large enough to take my tent. During the two days it was erected, the male stood, or walked up and down, six feet away and kept the young ones at a distance. Every time they wandered within range of my lens he uttered a sharp "kluit," and mechanically they retraced their steps. But as soon as I took away my tent they paddled inshore as usual. That was my last visit to the colony. I took leave of them and of their guardian, the Dutch farmer, and his family, very regretfully. We could not converse, but the farmer's wife always anticipated my wants. Not the least delightful of my recollections is the tea which was always ready for me in the farmhouse kitchen; the men's faces, half in shadow, with the fire-light playing on them, and the pleasant, homely-looking woman and children—all might have stepped out of the canvas of some sixteenth-century Dutch Master.

THE SCIENCE MUSEUM.

A SPECIAL exhibition of instruments and apparatus, which are used in various geophysical sciences, is now on view at the Science Museum at South Kensington. The Government Pavilion at the British Empire Exhibition can only find space for some of these at any one time, so that the remainder are being shown at South Kensington, where they are being supplemented by many objects of great historical importance from the Museum collections. The departments of science which are thus specially represented are Geodesy, Meteorology, Gravity Surveys, Seismology, and Terrestrial Magnetism, and of these, not only are some of the most recent instruments on view, but also many which are of historical importance in the development of these sciences. This exhibition will remain on view until the end of October, and will be supplemented by such objects as, having been exhibited in the Government Pavilion at Wembley, have been removed to provide space for others.

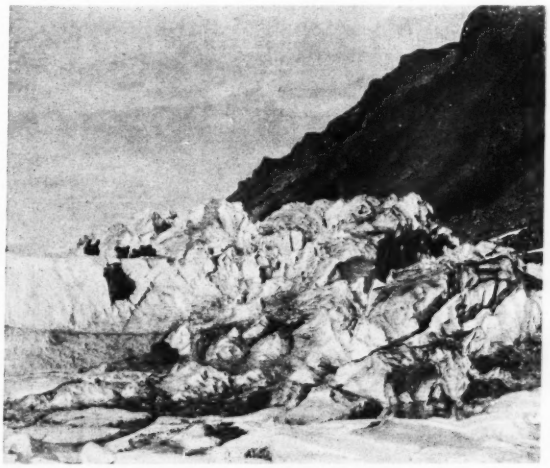
Mapping North Greenland.

DANISH EXPLORER'S RECORD SLEIGH JOURNEY OF 3,600 MILES.

By H. T. Shepstone.

Little is known of Greenland, which has been kept as a closed protectorate by the Danish Government. Dr. Lauge Koch, who recently lectured at the R.G.S., has now completed his six years of survey work, and the results are being published to the world.

DR. LAUGE KOCH, the famous Danish explorer, who has been lecturing before the Royal Geographical Society, and who is to speak on his recent feat in mapping the unknown north-west coast of Greenland before other scientific institutions both here and in America, is rendered all the more timely by the announcement of the decision of the Danish government to erect four wireless stations in Greenland, and to modify her policy of isolation so far as trading with that northern possession of hers is concerned. The wireless stations should prove invaluable as an aid to forecasting the weather. Meteorologists have always contended that what was needed to make their forecasts more complete and reliable were prompt and systematic records from this quarter of the globe. Then the Danish Parliament has before it the report of the delegation which it dispatched to Greenland last summer to discover, by investigation on the spot, how the administrative policy regarding the trading rights of the country could be modified to meet changing conditions. The aim here is to find some means of developing the trade of the country so as to render it more self-supporting, and yet assure protection to the 20,000 Greenlanders or Eskimos who dwell there.



SLEDGE CROSSING A CREVASSE ON THE ACADEMY GLACIER.

Sheep Farming.

Coal and copper exist there, while there are also important cryolite quarries. Of recent years sheep-farming has been introduced into Southern Greenland, the flocks to-day numbering over 2,000 head. Goats are also being successfully reared, and the Arctic Fox farms have proved a success. It is the opening of the delegation that the main line of development should be in regard to the fisheries.

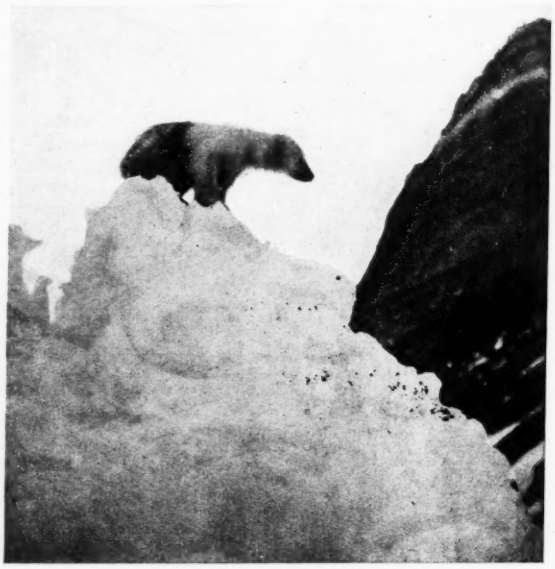
At present no one can land in Greenland without the permission of the Danish government. The object here is to protect the Eskimo from outside evils, such as drink and disease. So far it has proved a wise measure, but it is now felt that the time is right for modifying this policy of isolation. While Greenland has been a closed country to the outside world, scientists and explorers have always been encouraged, and during the last decade or so Greenland has been crossed from east to west and from west to east by private expeditions. Then the Danish Geological and Geographical Researches Committee have sent some sixty expeditions into Greenland since 1876, and have issued some sixty volumes dealing with scientific questions concerning that country. The latest expedition is that recently completed. It is known as the Jubilee Expedition, so named in honour of the bi-centenary of the Danish colonization of Greenland. It had for its object the important work of mapping and surveying the last section of the north-west coast of Greenland. The east coast had already been mapped by Danish explorers, particularly by the late L. Mylius Erichsen, and it was only fitting that a Dane should carry his country's flag over the remaining portions of the coast. The expedition was financed partly by State and partly by private funds. Dr. Lauge Koch, who has spent some eight years in Greenland on expedition and scientific work, was selected as leader. He was a member of the second Thule Expedition led by Mr. Knud Rasmussen which filled in the gaps on the east coast as far north as De Long Fiord.

Dr. Lauge Koch planned to carry the work right up to Cape Bridgeman, the most remote and inacessible part of Peary Land. It called for the undertaking of the longest sleigh journey on record, a trip full of risk and peril, across glaciers and over the dreaded ice-cap, of 3,600 mi'es, which was covered in two hundred days.

Inglefield Gulf, just beyond Cape York, was selected as a base, and here, during the winters of 1920-1921, all necessary preparations were made. The plan was to survey the north coast thoroughly to Cape Bridgeman and then make a dash home across the ice-cap from the head of Independence Fiord to Washington Land — a distance of not less than 420 miles. The outfit consisted of Eskimo sledges drawn by a team of eight to ten dogs each. The provisions consisted of pemmican for men and dogs, and oatmeal, chocolate, sardines, and coffee. A large quantity of provisions were carried so that on the outward journey the survey work along the north coast would not be unduly

Snow Shoes.

delayed by hunting. For travelling along the coast the party were equipped with Canadian snow-shoes, while skis were carried for use over the ice-cap. The equipment also included three magazine rifles, two shot guns and one revolver, as well as two tents which could be also used as sails for the sledges which were so designed that they could be converted into boats.



A POLAR BEAR SNAP-SHOTTED IN WASHINGTON LAND.

A start was made on 18th March, 1921, the expedition consisting of 19 sledges, 200 dogs and a few chosen Eskimos. Dr. Lauge Koch was the only European in the party. The ice was found to be excellent, and Cape Alexander was skirted to seaward instead of crossing the ice-cap. At Etah five sledges were sent back, and on the famous ice-foot of Inglefield Land the party sledged up to the 79th parallel. Most of the time the temperature was — 40°C., and in the shade of the hills to the south both men and dogs suffered a good deal from a very unpleasant frozen mist. By 17th March, Washington Land, in 80° N., was reached, when another five sledges were dispatched back to the base. In Kennedy Channel the ice was found to be very hummocky. Several times the sledges were wrecked, necessitating considerable repairs.

A New Disease.

At Fort Conger, on Grant Land, which was reached on April 5, the party found the provisions placed there the year before for Captain Ronald Amundsen in good condition. Hunting being excellent, the party rested here for a fortnight. One reason for this rest was because they had all become infected with a curious itch-like disease, especially prevalent on the legs. It had been contracted from an Eskimo from Cape York. He had it at the start, but at Fort Conger the disease had developed into very severe psoric pustules or boils, combined with feverish attacks. At the settlements the disease lasted throughout the whole summer and several persons died from its attacks.

After crossing Robeson Channel the expedition landed at Frankfield Bay in 82° N. lat., when the rest of the auxiliary sledges were sent back to the base, which reduced the party to four men, three sledges, and thirty-two dogs. After a most trying journey Beaumont Island was passed, and on 1st May, the 83rd parallel was reached. Four days later the party were off De Long Fiord, thus passing the northernly point reached by Knud Rasmussen in 1917. Here the expedition was divided into two parties, one of which, consisting of two Eskimos with the best teams and most of the outfit, continued its way to Cape Bridgeman to hunt and, if possible, to accumulate provisions of fresh meat. The other party, consisting of Dr. Lauge Koch and a single Eskimo, continued the surveying work along the coast, reaching Cape Bridgeman on 13th May, when they at once set out for the pack-ice north of Greenland. "On the morning of Whitsunday," says Dr. Koch, "I finished my surveying work and found the latitude to be 83° 50″ N. My tiny flag waved lustily from my surveying rod beside the theodolite, marking the north-most point ever reached

A BIG SEAL KILLED BY ESKIMOS AT JORGEN BRUNLAND FIORD.

by the *Dannebrog*, whilst to the south the mountains of Greenland lay in a thin bluish haze . . . . On May 21 I was able to fly the colours of my country from the cairn built by Colonel J. P. Koch, and thus the *Dannebrog* had now flown along all the coast of Greenland. It was a grand day to me, as I had now fulfilled the aim I set myself when eight years ago I came to Greenland for the first time. The last remaining part of the Greenland coast was surveyed."

Now came the return journey to the base. Provisions were none too plentiful. The Eskimos on their way northward had secured but fifty-three hares and one wolf. Unfortunately the party ran into a fearful

Narrow Escape.

snowstorm which lasted over a fortnight. Their last pemmican had been eaten and one after another the dogs collapsed, and they had to pull on the ropes to assist the remaining dogs. Imagine their delight, therefore, when they caught a glimpse of a herd of musk-oxen. Before they could get within range, however, a fog came rolling up and it was not until thirty-six hours later that they found the animals and secured the whole bunch of nine. The youngest of the Eskimos here cast aside all his stoicism, and, standing amidst the steaming carcases, half-naked and smeared with blood, with two musk-ox horns as a drum, he sang the ancient magic incantations of his tribe, while white and heavy flakes of snow continued to melt on his brown chest and shoulders.

One significant discovery was that the depression, known as "Peary Channel," is not a channel at all, but a big valley. Now came the ascent of the ice-cap. Climbing the Academy Glacier proved trying and hazardous on account of the numerous creeks and rivulets that crossed the party's path. Several times they had to hoist their sledges over vertical ice fronts or over steep hill-slopes. For crossing lakes the floats were brought into requisition while the men paddled across on snow-shoes and skis. It was hoped that on the Nuntatak Vildtland they would find musk-oxen, but the hunters returned without results. This was serious, and everyone understood that it meant short rations during the forthcoming crossing of the dreaded ice-cap, their provisions having been reduced to a few strips of musk-oxen, a dozen or so frozen hares and a little coffee without sugar.

A detour was accordingly made to Warming Land where in 1917 the second Thule Expedition started on a desperate race for life across the inland ice which caused the death of Dr. T. Wulf. Here they expected to find a cache which was to have been placed there by the Eskimos, but disease having broken out amongst them this had not been done. They had now only ten dogs left, and the situation was serious. The nearest cache at Cape Forbes, on Washington Land,

ROUGH GOING OVER THE ICE HUMMOCKS.

was still 180 miles distant. The leader was still anxious to finish the survey work around Petermann Fiord, and it speaks well for the spirit of the Eskimos that they made no demur to the delay this entailed. They had to cross the Petermann Glacier which all previous explorers had hitherto avoided because of its terrible crevasses. For safety, men and dogs were roped together, and the crossing was effected with

only the loss of one dog. They had certainly reduced the distance to sixty miles, but there were only four dogs left, which meant life for four days.

Saved by the Wind.

Their rescue came on August 11 in the shape of a heavy gale from the north. They tied the dogs to the sledges, put up their sails, and with the speed of an express train rushed towards the depot. They negotiated large frozen lakes and several times the ice-cover broke, but, owing to the speed they came out all right. In a few hours more than twenty-four miles were behind them, but when the gale was at its height they had to take down the sail as the speed was becoming dangerous. By this time, however, they could make out the depot with their field-glasses. They were now stopped by a large glacial stream and, utterly exhausted, they were glad to camp, knowing that the next morning would bring them food. During the night one dog died from starvation. Crossing the river was found to be very difficult and one of the Eskimos had a very narrow escape. When the cache was reached the oldest Eskimo, who during the whole journey had taken upon himself the hardest work, collapsed, but after a short rest and food he recovered. In the early days of October the base was reached. All had returned safely and the explorer's plans had all been carried out. The mapping of the territory between Independence Fiord and Humboldt Bay was completed on 10 sheets to a scale of one to 200,000, while the whole northern area from Upernivik around Denmark's Fiord was also covered.

Dr. Lauge Koch attaches great significance to the geological results of his expedition, and has brought back some 4,000 geological specimens, including fossils of animal life from the earliest period, and of both European and West American forms. But the most practical significance of the expedition will probably be the completion of the mapping of North Greenland.

The Obsidian Religion of Ancient Mexico.

By Lewis Spence.

Author of "The Gods of Mexico," "The Civilization of Ancient Mexico," etc.

An astonishing article of the greatest importance. Mr. Spence sets forward a theory that, underlying the later Mexican religions, is an original cult based on the stone obsidian, just as early Chinese cults are associated with the stone jade. This new discovery is the considered result of twenty years of research.

As everyone engaged in research is aware, there comes a time when the subject of study assumes an aspect so thoroughly at variance with one's original conception of it, that the student is aghast at the extraordinary change presented. Generally, such an experience is the fruit of prolonged application and contemplation. In my own case it required more than twenty years of research and groping in the difficult field of Mexican Religion to realize that underlying what I had always believed to be the official faith of the Aztecs, was a still earlier cult connected with the obsidian stone.

I was, of course, well aware that obsidian played a certain part in Aztec religion as a ceremonial object in use on sacrificial and other occasions, but the full measure of its importance did not dawn on me until I began to arrange the gods of the Mexican pantheon into groups. During this process I observed that the names of at least three of these included the Mexican word for obsidian, itztli. One of these gods, indeed, was known as Itztli, the other two being Itzpapalotl ("obsidian butterfly") and Itzlacoliuhqui ("curved obsidian knife"). I knew that Tezcatlipoca, one of the principal Mexican deities, was frequently represented as an obsidian knife, and that the native Aztec paintings were crowded with pictures of this symbol, which occurred so frequently that I could scarcely be mistaken in placing a high value on its religious significance.

Obsidian and Jade

I had before me at least one other analogy. The importance of jade in Chinese Religion and Folklore afforded me much food for thought. I knew that the implications of the beautiful jade stone permeated the whole of Chinese legend, folk-belief and theology. Then I observed that several of the Mexican gods were represented as wearing sandals made of obsidian, and the sandal, I had formerly discovered, must often be taken as an indication of the significance of a Mexican god. In fact, the longer I searched, the

more traces of obsidian did I find in Mexican lore. The image of the god Tezcatlipoca, the mirror in which he beheld the doings of humanity, his death-dealing arrows, were all of obsidian. The very cloak he wore was, I found, merely an adaptation of the net-bag in which the Aztec hunter carried his obsidian arrow-heads.

I found, too, that such deities as were connected with obsidian were exclusively those worshipped by

GOD MIXCOATL HOLDING LIGHTNING DART.

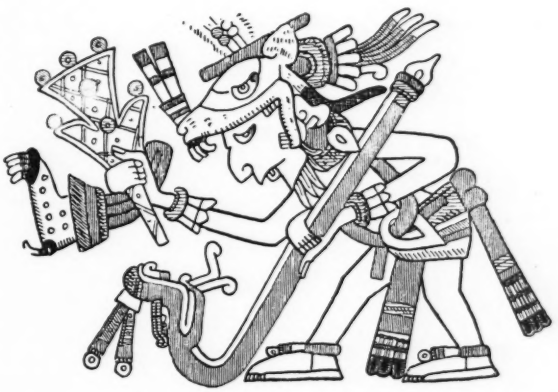
the Aztec or Nahua tribes of Mexico, and that the cults of Quetzalcoatl and Tlaloc, deities of older precedence in the land, were associated with it in a secondary manner only, and very slightly at that—that, indeed, their associations were with the chalchihuitl stone, or native jadeite.

I resolved to follow up these clues, and did so with the following results :—

Primitive Commodity.

Obsidian is a vitreous natural glass, found in the upper volcanic strata of Mexico and California, which flakes readily from the core by pressure and gains by mere fracture a razor-like edge of considerable penetrative power. The principal quarry of this volcanic glass was the mountain known as the Cerro de las Navajas, or "Hill of the Knives" near Timapan, and from this centre obsidian was widely distributed by barter over a very considerable area. There would seem to be proof that this mineral, so suitable for the purposes of the nomadic hunter, was anciently known far to the north of Mexico. The observations of Dr. G. M. Dawson in British Columbia about 1890, satisfied him that trading intercourse was engaged in by the coast tribes with those of the interior along the Frazer River Valley and far to the south. From the remotest times embraced in their native traditions, the Bilquila of Dean Inlet have possessed a trade route by way of the Bella Coola River to the Tiñné Country, along which trail broken implements and chips of obsidian have been found. Many of the routes in British Columbia have also yielded chips and flakes of obsidian. The coast tribes of British Columbia have been traders for untold generations, exchanging oolactin oil for such materials as they could make implements from, and there seems to be no doubt that the Mound-builders of Ohio, Wisconsin and Kentucky were also acquainted with obsidian, which they could only have obtained through the process of barter. It was thus either to be found in the regions from which the Nahua of Mexico are thought to have come, or else obtainable through the channels of trade.

The Nahua were thus probably acquainted with obsidian and its properties before their entrance into Mexico. This hypothesis is strengthened by the material difference in workmanship between their tools and weapons made of this mineral and the stone and copper implements of the aboriginal peoples of Mexico. It was naturally as a hunting people that they employed weapons of obsidian. The herds of deer, on the flesh of which they chiefly lived, roamed the steppes, and proof abounds that the customs of the chase strongly influenced the religious ideas of the early Nahua. Certain of their gods, indeed, seem to



MIXCOATL AS GOD OF THE DEER.

have been developed from cervine forms, for among barbarous races the animal worshipped is frequently that which provides the tribe with its staple food, or, more correctly, a great eponymous figure of that animal is adored—for example, the Great Deer who sends the smaller deer to keep the savage in life. These

deer-gods, or hunting-gods in some way connected with the deer—Itzpapalotl, Itzcuêyê. Mixcoatl, Camaxtli—had also stellar attributes. The deer was slain by the obsidian weapon, which, therefore, came to be regarded as the magical weapon, that by which food was procured. In the course of time it assumed a sacred significance, the hunting gods themselves came to wield it, and it was thought of as coming from the stars or the heavens where the gods dwelt, in precisely the same manner as flint arrow-heads were regarded by the peasantry of Europe as "elf-arrows" or "thunder-stones"—that is, as something supernatural, falling from above.

When the nomadic Nahua tribes, of which the Aztecs were one, adopted an agricultural existence, obsidian had doubtless been regarded as sacred for generations. It was by virtue of this supernatural stone that the nourishment of the gods was maintained by the sacrifice of deer. By the aid of lances and arrows fashioned from its flakes deer were more easily slaughtered than with clumsier stone weapons. With these primitive hunters obsidian took much the same place as bronze did with the Neolithic peoples, and came to be regarded as the chief agency through which the necessities of life were acquired.

Human Sacrifice.

But when the Nahua embraced a more settled existence the nourishment of the gods had necessarily to be maintained by other means than the sacrifice of deer, which were gradually disappearing. Slaves and war-captives were sacrificed instead of beasts of the chase, and at the festival of Mixcoatl, women were sacrificed in the place of deer, their wrists and ankles being tied together precisely in the manner in which a deer is trussed by the hunter. The transition of deer-sacrifice by obsidian to a human holocaust and from the hunting to the agricultural condition of life is well illustrated by an ancient hymn in praise of the goddess Itzpapalotl:

"O, she has become a goddess of the melon-cactus,
Our mother Itzpapalotl, the Obsidian Butterfly,
Her food is on the Nine Plains,
She was nurtured on the hearts of deer,
Our mother the earth-goddess."

The inference in these lines seems to be that whereas Itzpapalotl was formerly a goddess of the Nahua nomads of the steppes in the north of Mexico, who sacrificed deer to her, she has now become the deity of the melon-cactus patch and an agricultural community.

Mexican traditions make it very clear that obsidian, because of its blood- and life-procuring properties, came to be regarded as the source of all life, as the very principle of existence. Tonacaciuatl, the creative goddess, gave birth to an obsidian knife from which sprang sixteen hundred demi-gods who peopled the earth. In the native paintings, maize, the chief food of the people, is often pictured in the form of an obsidian knife-blade. Just as in many myths, both in the Old World and the New, flint was regarded as the great fertilizer because of its supposed connection with the lightning, so was obsidian. Thus, all the elements which go to make for growth and life came to be regarded as having a connection with this mineral,

Magic Mirrors.

even the sun itself being identified with the mirror of Tezcatlipoca. The hunter's obsidian weapon, which supplied the necessary pabulum, became in turn the weapon of the warrior who procured victims for the holocaust, and the sacred knife of the priest who sacrificed them to the deity. Obsidian was thus chiefly the war weapon and the sacrificial weapon,

THE GODDESS ITZPAPATOTL, THE "OBSIDIAN BUTTERFLY."
Note obsidian knife in the headdress.

but the traditions relating to it are associated with all the offices of human art, industry and activity, and well illustrate the inter-relations of early religion with war, labour, art and law.

Probably after a long career as a fetish, obsidian at last became personalized or deified, just as grain achieved a personality as Osiris or John Barleycorn. The process of development from fetish to god is a fairly clear one. From obsidian were manufactured

the mirrors or scrying-stones in which wizards or necromancers pretended to see visions of the past or the future. These were known as aitztli, or "water obsidian," probably because of the high polish they were capable of. One of these is carried by Tezcatlipoca. Many deities when they arrive at that stage of development when they take human shape continue to be represented along with their fetish or totem shape, and that this was so in the case of Tezcatlipoca admits of no doubt, as one of his minor names is Itztli or "obsidian," and his principal title itself means merely "Smoking Mirror," and, as we have seen, his idol was carved from obsidian. Obsidian, the great life-preserver and food-getter, became identified in the form of this god as one of those magical stones which are considered capable of raising a storm, and therefore with the wind, the cause or breath of life.

Obsidian thus came to be looked upon as the symbol of life, with every manifestation of which it had interrelations. Just as the oak-cult of the Druids seems to have given an oak-like virtue to the oracular birds which dwelt within its branches, to the soil from which it grew, to the sky above it, to the priests who ministered to it and to the sacred implements they employed, just as the idea of jade permeated all Chinese life and thought in early times, so the obsidian idea came to have ramifications in every department of Aztec life. In course of time this peculiar faith gradually became amalgamated with the rather more "civilized" cults of Quetzalcoatl and Tlaloc. But it left its mark upon Mexican religion to the last, its symbolism persisted, and no view of Aztec faith is complete which does not take it into consideration and regard it as a fundamental in the upbuilding of one of the world's most interesting religions.

The Spell of the Southdowns.

By Eleanor Shiffner.

Here is an article about your own country that is just as new and interesting as one about black men in Africa. Why not enjoy a voyage of discovery in Sussex?

THERE is a certain fascination about the Southdowns which can be felt, but is very difficult to describe; the perfect quietness and freedom of them seem to have a great deal to do with it. It does not matter to a true lover of these Downs how many years they may have spent away from them, but they are always delighted to get back to them, and they can always find something fresh to interest them. But there are some people who can find no charm or pleasure about them, as I had the remark made to me "Oh! that is the place where you walk and walk and walk and never get anywhere." Personally, I have spent many happy days, right away in the very heart of them, with no sound or sign of life except for the songs of the birds, and the rabbits playing around. Towards evening there are many hundreds of the latter to be seen either nibbling the grass, or else running about in and out of the bracken and gorse bushes.

Scented Gorse.

When the gorse is in flower the whole place is a blaze of yellow, and scented with the smell. One day I was sitting under some old wind-swept thorn trees, which must have been standing there in cold and heat, storm and calm, a great number of years, and thought if they could only speak what stories they could tell of poachers and keepers, and how the foxes and stoats caught the rabbits, and the cubs played about, and then, during the hunting season, how the tables were turned and the foxes were hunted and killed in their turn, and how the badgers roamed about at night. Presently a shepherd came past with his flock, carrying his crook and accompanied by his dog. Some of these crooks are hundreds of years old, having been handed down from father to son. The making of them used to be an old Sussex industry and were chiefly made at Pyecombe, a small village near Brighton.

An old shepherd who lived in this village thought the ones which were made elsewhere were "terrible useless things." During the summer months it must be a very pleasant life up on these hills with the sheep, and then towards evening to wend their way home down into the weald below, but a very different story in the winter, with a biting east wind, or being caught in a snowstorm or thick fog, and the latter can be very bad, and anyone not thoroughly knowing their way can very easily be lost. An old keeper who knew every bush on the Downs told me how even he once got lost during a very dense one. In olden days these shepherds used to add very considerably to their wages by catching wheatears; some used to make as much as £20 to £50 during "the season," which lasted from July to September, during which time the birds were migrating. They came in pairs and small parties at first and spent a few days on the hills to rest before beginning their voyage over the sea to a distant continent. These poor little birds were considered

a very great delicacy, and the "gourmets" would pay any money for them. In July the shepherds would begin to make their coops or traps, which were a T-shaped trench about 14 in. long, over which two long narrow sods cut out of the turf were laid, grass downwards. A small opening was left at the end for the bird to go in at, and there was enough room left for it to pass through to the other end, where a horse-hair spring was set, in which the bird was caught round the neck as it went in. In some places so many of the traps were set, the ground looked very much like a ploughed field. As the habit of the birds is to alight on a stony or barren piece of ground, this attracted more birds. The weather made a great deal of difference to the number caught. On a bright, clear day, there would be very few, but a day in which there were a lot of flying clouds about would be a good day for the shepherds, as directly a cloud obscured the sun the birds expected rain, and would pop into the holes for shelter and get caught. At the end of the day the birds were taken to the poulterers in the nearest town, or sometimes people would drive

SHEPHERD WITH CROOK ON SOUTHDOWNS.

Wheatears.

out and get them direct from the shepherds. About the year 1880 the farmers began to forbid their men to catch the birds, as they found they gave most of their time to it and neglected the sheep and their work. At the present time the number of Wheatears have so very greatly decreased that it would not pay any one to restart "the trade." Also I am sorry to say the shepherds and their sheep are also fast disappearing from off the Downs, and the place being all wired in and cattle turned out in their place. Somehow they do not seem to suit the Downs in the same way as the sheep who seem to belong to them, also all the fencing does away with the "freedom" of the Downs; as the old glee states, "Who will o'er the Downs so free?"

Another of the old Sussex features which has practically disappeared is the "Working Oxen." It was a very pretty sight to see them ploughing on the cultivated parts of the Downs; they were also supposed to be very good for the land as they trod it so thoroughly. When carrying corn they were most picturesque. These oxen were introduced from Wales about a century and a half ago, and were fine long-horned black ones. The original Sussex oxen were red. I do not know why the change was made. In olden days when the Sussex roads were noted for their excessive badness, the only animals that could get through the mud were the oxen, and it was a very common sight to see people being drawn to church by them. These animals were broken in at the age of two years. No bits or reins were used, but they were guided by a man with a long stick or "goad" as it was called, made of hazel.

The Yoke.

The yoke which spans the necks of a pair of oxen is made of willow ash. A bow encircles the neck and passes through the yoke. These yokes are connected by a central chain, the end of which is secured to the plough. If attached to a wagon or cart, a pole or "neb" is used instead of the chain. The drawback to these animals is their slow pace. A good team would plough about an acre per day. A great many farmers used to employ them, but they have been gradually given up, and horses taken their places, and now tractors are used; the latter may be quicker and get more work done, but no living person can say they either add to the beauty or quiet and peacefulness of the country. The last team around Lewes was given up in the year 1912, but I believe there is still one farm on which they are used somewhere near Seaford; at least they were about a year ago.

During the war a great deal more of the Downs was broken up and corn grown, but now a lot of it has been given up again. Yet another feature which has almost disappeared and is very greatly missed as they were regular old landmarks, is the windmills. They used to stand on the highest point so as to catch all the wind. These mills are of a very old origin, the first known mention of one in England being in

the chronicle of Joseline de Brakelonde about 1190, when a windmill built by Herbert the Dean, at Haberdon in Suffolk, was ordered to be destroyed by Abbott Samson. In 1216 there is another record of the ravages of a storm which blew down many mills. In the year 1302 there was a very severe frost which

OXEN CARRYING CORN ON SOUTHDOWNS.

damaged so many watermills that windmills were used much more extensively.

Refugee.

Two of the Sussex windmills were of historical importance. On May 14th, 1264, at the Battle of Lewes during the flight of Henry III's troops, Richard, the King's youngest brother, took refuge in a windmill, barring the door, but after some time he had to surrender himself to Sir John Befs. One of the hills near Lewes is called Mount Harry in memory of this battle. The other mill mentioned was at Winchelsea where King Edward nearly met his death in August 1297, when his horse was frightened by the noise of the sails and jumped the bulwarks. There are two kinds of mills, i.e., the post and smock or tower, the former being the older of the two; it is mounted on a massive upright post, usually made of oak, which rests upon a hollow stone in such a way as to allow of the whole structure being turned round according to the way of the wind.

The smock mills are constructed quite differently, the tower is principally of brick and is stationary, and surmounted by a movable top which carries the wind-shaft to which the ponderous sails are fixed. For several centuries these sails were composed of wooden frames over which sailcloth was stretched, but this was not very satisfactory and shuttered sails took their place, these being mounted on spindles upon which they turned, so allowing a certain portion of wind to blow through them. All the mills on the Downs near Lewes were of the latter kind. The mill depicted on the cover of this issue was always called "The six-sweep Mill," as it had six sails, all the others having only four. It was blown down in a gale during the war. There are very few left now, they having either been burnt down or destroyed as being unsafe. There is one at Glynde, and two close together on Clayton Hill; one of these has been turned into a summer residence, having had the sails removed; the other one is still standing. Mills were often used by the smugglers for hiding their kegs, etc.

Dew Ponds.

Walking along the springy turf one comes to a pond, which is one of the dew ponds and peculiar to the Downs. These ponds are very rarely empty, except in an exceedingly dry summer, and are used for the sheep, or at the present time for the cattle. They are a broad circular pan-like depression and are always on the top of a ridge, with no spring or source of supply near. During rain these ponds fill quickly and when once full the supply is kept up by the condensation of the thick damp mists and dews, hence the name of Dew Pond. Unless one has been out in one of these damp mists it is impossible to realize how much wet falls; very often when it is quite clear in the Weald there are thick rainy clouds which quite hide the top of the hills. Here moles abound in large numbers, and their "hills" and runs are to be found on the very highest points. As these animals require a lot

WHEATFIELD ON THE SOUTHDOWNS.

of water it is marvellous how they can exist at this height, away from water except for the dew ponds. One year when it was an extraordinarily dry summer, these ponds were dry, and there were a certain number of dead ones found, but numbers of them lived. Of course, they may have been helped by the dew, but there were many nights when there was none of that. These animals are remarkably strong. I held one in

my hand once, and it was all I could do to prevent it getting through my fingers. They eat a tremendous quantity of worms. I kept one for a night and gave it a large boxfull of earth and, as I thought, plenty of worms, but in the morning it was dead, and a friend of mine told me I had not given it half enough. As I have already stated, rabbits abound on these Downs, and they afford very good sport. There are also partridges to be had. One of the prettiest sights is in the early morning as the sun is rising during the cubbing season, to see hounds running through the bracken which has turned to a beautiful yellow colour, and to watch them hunting over the hills.

A few days ago I spent a long day in a favourite valley of mine. The chief sound to be heard was the joyful song of the larks, and I watched one soaring up into the sky. After going up a good height it began slowly to descend and finally "nose-dived" on to an old stump where it finished its song and then flew on to the ground in search of food. Presently four magpies flew past uttering their harsh chattering cry, two alighted on the branches of a thorn tree close to me, and the others on the ground; they only remained a few minutes and then flew off again. No sooner were they gone when two kestrels came overhead; one hovered as though it was going to swoop, but evidently its prey had hidden itself, as it flew on. These birds nest in a chalkpit close by. Presently a nightingale began its delightful mellow song, and the cuckoo uttered its monotonous "remark," and mingling with it all was the cooing of the wood pigeons.

Voice of the Open.

On passing a small gorse bush I was surprised to see a little owl dash out, and settling on the ground a short distance off it glared at me. Two goldfinches flittered about uttering their "tweet! tweet." In the autumn these birds are seen in flocks, very often sitting on the thistles, picking out the seeds. At one time they were becoming very scarce, but now the "bird catchers" have been stopped more or less they are becoming much more numerous. A jackdaw was living up to its inquisitive reputation, as it had found a piece of paper which someone had left lying about; it was rather afraid of it at first, but finally screwed up its courage and poked its head underneath, evidently hoping to find at least a piece of cake. At the same time there was to be heard the familiar "merry laugh" of the green woodpecker, as it flew into an oak tree, the sun showing up its handsome green and yellow plumage. It had probably bored itself a nesting-hole in one of the trees near by. Practically the whole of one side of the valley was thickly covered with yellow cistus, intermingled with wild thyme, which scented the whole place. The May blossom was over, but the elder bushes at the bottom of the valley were white with blossom, also there was quantities of honeysuckle twining itself among the bushes and brambles. As the sun was just setting I thought it was time to move as I was several miles from home.

JADESTONE.

ALTHOUGH it is generally agreed that Burmese jadestone belongs to the mineral species known as jadeite, the means of distinguishing it from jade proper and from other groups of minerals, including bowenite and some varieties of serpentine, are not always easy. Prehistoric implements of jade and jadeite are well known, the latter being common in parts of China, but the possibility of many of them being modern copies of ancient prototypes should not be overlooked, as the stone is still believed to possess magical properties as a charm by Eastern races.

Although objects fashioned from Burmese jadeite, such as strings of beads, plaques for pendants and small carvings, are familiar objects in the jewellers' shops of London, Paris and New York, the real market for the stone is, as it has been for centuries, in China, which the mineral reaches by sea from Rangoon to Canton, or overland through Têngyüeh. It is noteworthy that conditions of general prosperity in China stimulate jadeite-mining in Burma, while famine, pestilence and civil war make it stagnant.

Jadeite is worked at Mamon, Hweka and Tawmaw in the Mogaung sub-division of the Myitkyina district, Upper Burma. It is obtained *in situ* from a serpentine dyke and as boulders from alluvial deposits. The royalty on the stone is collected under a pernicious system of "farming out," the official returns of production are quite misleading, for large quantities are undoubtedly smuggled over the Burma China frontier to Têngyüeh. The official export returns show an annual average of 4,651 cwt. for the five years ending 1918-19, the value being £74,498 or £16.02 per cwt. There can be no doubt that these declared values are very much underestimated.

The commonest colours assumed by Burmese jadeite are a brilliant white, spotted marbled-white, greyish, pale greenish-white, or the most delicate, translucent, purplish-white background, flecked or mottled with very vivid apple-green. Emerald green, and dark green shades are not so common. Pale amethystine and red tints are rare. The translucent white material with bright green spots is perhaps the most highly prized.

The Young Herring, Pilchard and Sprat.

By Marie V. Lebour, D.Sc., F.Z.S.

It is only in recent years that scientific research has been seriously concerned with the life history, breeding and development of sea fishes. There are still mysteries associated with the movement of the herring shoals and the subject is one of the first importance.

In the summer months on the coast of Devon and Cornwall there are always to be seen shoals of small silvery fishes, usually about two to four inches long, swimming close to the shore and penetrating up the river estuaries. The fishermen will tell you that the "britt" or "mackerel britt" have arrived and welcome them as bait for other fishes and as the herald of the coming inshore of the Mackerel, for the Mackerel follow them in, feeding on them as they follow. A bucketful of the britt can be hauled up with ease from a boat or even from the land. On examination they are seen to be little fishes belonging to the Herring family, in fact they are a kind of Whitebait. On closer examination one finds there may be three different fishes mixed in varied proportions. Those that appear earliest in the year are baby Herring, about four or five months old, and these are often mixed with Sprat which are usually smaller and younger. Later on in the summer Pilchards also occur and all three fishes may be found together. The south country Whitebait may thus consist of Sprat, Herring and Pilchard, whilst that of the Thames and also of the Firth of Forth consists of Sprat and Herring only, sometimes mainly Sprat, at other times mainly Herring.

It is interesting to find out something about the life of these fishes so common and so important, and as we learn more so do we find out how little we really know.

A Mystery.

The Herring of Cornwall and Devon enter the Channel to spawn along the coast in sheltered bays. Towards the end of October they may appear in large shoals, but nobody knows exactly where they come from. Probably the shoals are only formed at this time, the fishes, hitherto scattered, coming from the open sea, nearly ripe and in splendid condition. All through November, December and January the Herring fishery is in full swing; by the middle of February the fishes have all spawned and gradually disappear, the "spent" fish, or those that have spawned, being thin and flabby.

The spawn is deposited in sheltered bays. The eggs are small and sticky (the hard roe of the Herring) and falling to the ground adhere to each other and to suitable substances on the sea bottom. Each egg is round and measures about one millimetre or rather more across. The young fish is developing inside and in a fortnight or less, according to the temperature, it hatches out. As soon as it is out of the egg it makes its way by movement of its body and tail towards the surface where most of the food suitable to its tender age is to be found. The newly hatched Herring (Fig. 1) measures seven millimetres or rather more than a quarter of an inch in length, and is provided with a large yolk sac on which it feeds for the first few days

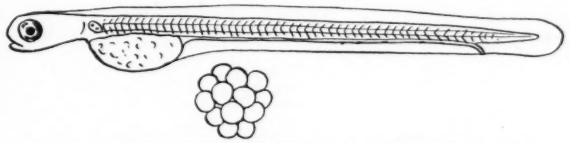


Fig. 1.—CLUSTER OF HERRING EGGS AND NEWLY HATCHED HERRING (Egg 1 mm. across, Fish 7 mm. long).

of its existence. This yolk sac is comparable to the yolk of a chick, but in this case, unlike the chick, the yolk is not completely absorbed before hatching. Eyes are fully formed, and the mouth is open, so that the little Herring can feed at any time; in fact, it does feed even before the yolk is absorbed. The body is long and slender and is surrounded by a perfectly simple larval fin running round the tail. By the second day these baby Herring may be caught in millions in the sea. They are glassy clear with only the bright dark eyes showing a gleam of colour. It has been asserted from watching newly hatched Herring artificially reared, that after the first day they can move upwards towards the surface at the rate of one fathom a minute. Even allowing them a much longer time in which to reach the surface it is certain that they succeed in arriving in the upper layers of water during the first few days after hatching. Except for this vertical movement the little Herring is at the mercy of waves and currents, and may be carried far from its original home.

Whitebait.

As the Herring grows it gradually changes; the yolk sac disappears in a few days and the true fins with rays begin to be formed. The little fish remains

transparent with a few black pigment flecks for some months, at a length of about forty-five millimetres, or nearly two inches, taking on its silvery covering, the scales appearing and the body becoming plumper and more like the adult Herring. It is now Whitebait size and soon begins to come inshore and up the estuaries in shoals. Throughout the summer these may be found, but they become scarce and finally no more shoals of tiny Herring occur. They probably scatter in various directions to feed and grow until in time they become mature.

The Pilchard is well known on the coast of Devon and Cornwall. It is like the Herring in many ways, but smaller and more oily, with much larger scales. If you hold it up by the fin in the middle of its back it hangs straight, whereas a Herring or a Sprat will hang head downwards, the fin being situated farther back on the body, behind the centre, in the two last fishes. The young Pilchard of about four to six inches in length is the Sardine of commerce. Although not nearly so abundant as it is on the coasts of France and Portugal, still the Pilchard is of considerable importance on the south-west coast of England, the Cornish Pilchard being celebrated. It is present in large numbers together with the Herring near the coast in autumn and winter and is caught in the same nets. Besides this winter fishery there is usually one also in the summer, and stray Pilchards may be caught at almost any time of year. In the case of the autumn and winter shoals, however, the fish does not come in to spawn like the Herring, but to feed, its food consisting of the various small floating organisms, known collectively as plankton, so numerous near the coast. The

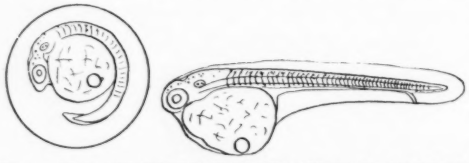


FIG. 2.—EGG AND NEWLY HATCHED YOUNG OF PILCHARD
(Egg 1.8 mm., Fish 3.5 mm.).

Pilchard spawns farther out to sea than the Herring, some miles from land and usually in water of a depth of not less than about twenty fathoms, often much more. The spawning period proper is from about April all through the summer, but scattered cases are found almost all the year round.

Food Reserve.

The egg, unlike that of the Herring, floats and is provided with a large oil globule. (The globule, however, is not necessary to flotation as many fishes' eggs float without one.) It measures from one millimetre and a half to nearly two millimetres across, and is characteristic in having a large space between the developing embryo and the egg capsule. Inside the egg the young Pilchard may be seen developing, and in a week or two it hatches out. The newly hatched fish is much more backward than the Herring and is much smaller, measuring only three millimetres and a half in length, its eyes have no pigment, the mouth is not open and the yolk sac is enormous. The fish thus is unable to catch, see, or eat any food, and is wholly dependent for the first few days of its existence on the nourishment contained in the yolk sac which still bears the oil globule seen first in the egg (Fig. 2).

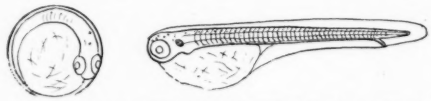


FIG. 3.—EGG AND NEWLY HATCHED YOUNG OF SPRAT
(Egg 1 mm., Fish 3 mm.)

In a few days the eyes are coloured, the mouth opens and very soon afterwards the yolk sac disappears and fin rays begin to form. The little fish is now almost indistinguishable from a Herring except by the eye of an expert. Like the Herring it is of glassy transparency, only the eye showing up conspicuously in the water, and it remains transparent until it reaches the length of about forty millimetres when it takes on its silvery coat and may be now regarded as Whitebait. At this size or rather longer it is to be found along the coast and up the estuaries in shoals together with young Sprat and slightly larger Herrings. It is obvious that they come in to feed on the numerous small animals so abundant in these regions. Later on it reaches the "Sardine" size, about three and a half to five inches or more. At this size it is scarcer on the British coast although present in enormous shoals in other regions. The young Pilchard alone is the Sardine proper. Young Sprats and other small silvery fishes, such as the Horse Mackerel, frequently canned in a similar way to the Sardine, have no right to the name. The Skipper Sardine of Norway, now known as "Skipper," is the Sprat. It is generally thought, although not yet proved, that the Pilchards scatter and shoal again at certain definite seasons.

The Sprat is perhaps more numerous than either the Herring or the Pilchard, and is present all the year round on our coasts. The adult is rather less than half the length of the Herring and proportionally smaller, with the body more flattened from side to side, and with distinctly keeled scales in a row on the under side so that the sharp edges can be felt if the finger be drawn along from behind forwards. The fishermen always use this test to identify the fish. The Sprat spawns closer inshore than the Pilchard but not

so near the coast as the Herring. Its egg, which is smaller than that of the Pilchard, measures about one millimetre across and also floats but has no oil globule and no large space between the embryo and egg capsule. In February and March the eggs are very numerous and occasionally occur at other times of the year.

The newly hatched fish is very like the Pilchard but without the oil globule. The yolk sac is large,

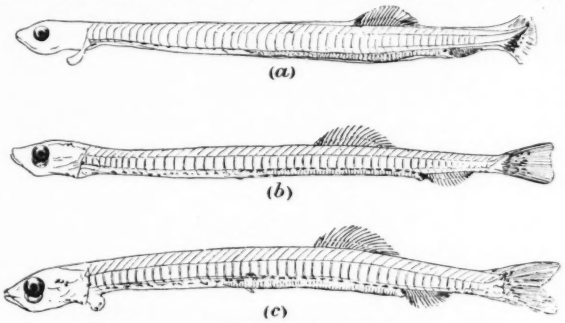


FIG. 4.—OLDER LARVAE OF HERRING, PILCHARD AND SPRAT (*a*) Herring 19.5 mm., (*b*) Pilchard 20.5 mm., (*c*) Sprat 20.75 mm.), Showing the Sprat to be the furthest advanced, the Herring the least.

Relatives.

the eye unpigmented and the mouth not yet open (Fig. 3). After losing the yolk sac the little Sprat is hardly distinguishable from a Pilchard of the same size but soon outstrips it in development and reaches the silvery stage much earlier. At a length of about twenty millimetres the Sprat is the furthest advanced, the Pilchard coming next and the Herring is the most backward (Fig. 4). Together as Whitebait with the Herring of a rather larger size, in their silvery coats they swim in shoals near the coast and up the estuaries in the spring, in the summer being joined by the Pilchards. Later they swim farther out and probably scatter to shoal again towards breeding time.

Another relative of the Herring which occurs more rarely in the Channel off our southern coast is the Anchovy, in either the young or the adult state. Specimens a few inches long are occasionally found in the stomachs of Mackerel taken in the Herring nets. The Anchovy can always be recognised by its peculiar mouth, the upper jaw projecting far beyond the lower. It is, however, an outsider compared with our three common Clupeoids, as the fishes belonging to the Herring family are called, and the Herring, Pilchard and Sprat constituting as they do such an important part of our British fisheries deserve all the attention that can be given to them, the elucidation of their interesting habits and life histories amply repaying anyone who may wish to study them.

It was suggested by Dr. Hjort of Christiania that the numbers of fishes depended on their food supply at the period when the young first took food. The baby Herring, Pilchard and Sprat certainly depend for their growth on the smaller plankton organisms usually so abundant in the upper layers of the sea, and if these fail the larval fishes would assuredly die. Unicellular plants and animals, larval molluscs and other small larvae constitute the chief food of these fishes when first feeding; later on it is the same kind of food but of a rather larger size. In fact, all through their lives they are truly plankton feeders, usually eating very large numbers of the smaller marine animals.

Their Enemies.

Sometimes the Whitebait may be full of larval oysters which abound in some of the estuaries. A rich plankton would thus provide a good supply of food to start the Herrings and their relatives on their way. However, among the various plankton organisms there are unfortunately not only those which serve as food for the little fishes but also many that eat the fishes themselves; the usual struggle for existence always going on. Indeed, the Herring itself is not above occasionally eating its own eggs or newly hatched offspring. The worst enemies are the small jelly fishes and sea gooseberries which are usually present in large numbers in the plankton together with the baby fishes and may often be found in the act of catching and eating them. As many as a dozen tiny Herring have been found in one sea gooseberry, and often several

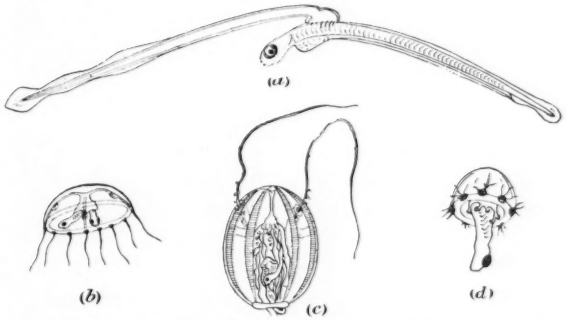


FIG. 5.—ENEMIES OF THE YOUNG FISHES EATING BABY HERRING AND SPRAT.
(*a*) The Arrow Worm Eating a Herring.
(*b*) A Jelly Fish with two Herring inside it.
(*c*) A Sea Goosberry Eating Herring.
(*d*) A Jelly Fish digesting a Sprat.

in one tiny jelly fish. The small and beautifully transparent Arrow Worms are also well known to be important enemies of the Herring, catching them with the strong hooks which arm the mouth and swallowing them whole, the worm and newly hatched fish being about the same size (Fig. 5). Not only do the small plankton organisms eat the Herring, but they are ceaselessly preyed upon by the larger fishes.

The Story of Mars.

By Norman Clark.

This article discusses the late Dr. Lowell's case for suggesting intelligent life on Mars. This month Mars will be nearer to us than it has been for a hundred and twenty years. Astronomers the world over will be making observations and new facts about the mysterious canals may be ascertained.

DURING the present month a most conspicuous, ruddy-coloured star will be seen hanging like a great red lantern in the southern sky. It is the planet Mars, our nearest neighbour outside the Earth's orbit, and on 23rd August it will be in opposition—the closest there has been for 120 years, and closer than any subsequent one will be during the present century. Though in our part of the world the planet will be a little too low for the best observation, to astronomers in more southern latitudes its situation will present unrivalled opportunities of testing the much disputed accuracy of the drawings of the late Dr. P. Lowell, considered by many to strongly point to the planet being inhabited; and in view of this, and also the proposed scheme of signalling to Mars, it is of interest to review shortly the chief Martian discoveries, distinguishing what is really known about the planet from the tissue of romantic lies with which such knowledge has often been enveloped.

Eccentric Orbits.

Before, however, we proceed to the story of Mars and the various points put forward in favour of its being the abode of intelligent beings, it must first be understood what is meant by the planets coming into "opposition," and why some oppositions are much closer than others. Here there are two points to grasp: first, that the planets make their orbits round the sun in different times, and, secondly, that these orbits are closer to each other in some places than at others. As regards the first point, Mars takes 687 days to complete its journey round the sun, as opposed to the Earth's 365; so that, about every two years two months, the earth catches up and overtakes Mars, and the planets are then said to be "in opposition." But—and here comes our second point—for observational purposes it makes all the difference at what place in the planets' orbits the opposition occurs at. For the orbits of the respective planets are not circles, but ellipses having eccentricities in almost opposite directions (in the case of Mars a very big eccentricity); and, as a consequence, such orbits are much closer in some places than others. Indeed, at their closest point they are only 35 million miles apart, as opposed to 61 million at their furthermost; whilst, again, the big eccentricity of Mars' orbit means that the planet is considerably nearer the sun at the point where the orbits are closest than on the opposite side. Thus, the combined result of these factors is that the planet not only appears to us much bigger at the close oppositions than the far ones, but also has more light thrown upon it and is considerably brighter.

Martian Discoveries in Brief.

Now the history of Martian discovery dates from the first use of the telescope by Galileo about 1610, when he found that the planet was subject to slight phases; and in the hundred years following different observers discovered the planet's rough rotation time, the white caps around its poles, and, in fact, most of the main marking one is likely to see with a reasonably good telescope even to-day. It was found in appearance to be a small round disc of orange colour, on which dark greenish markings could be seen; whilst around either one or other of its poles (and sometimes at both) were to be observed brilliant circular patches of white. Sir William Herschel, in the latter part of the 18th century, became convinced that the dark markings were of a permanent nature. He also proved that the size of the white caps around the poles corresponded with the Martian seasons, and expressed the opinion that they were caps of snow similar to those around the poles of the earth.

In 1830 came the closest opposition of the 19th century. Advantage was taken of it to lay the foundations of Martian geography, Beer and Madler making a systematic chart of the planet with lines of latitude and longitude similar to those on terrestrial maps. Other maps came later: Proctor's in 1869, Kaiser's in 1872, and Green's in 1877. But for the most part these maps showed little detail, and did little more than fix the position of the general markings found on the planet, which divided themselves into two branches—the dark markings seen south of the equator, and the bright orange areas, covering about three-fifths of the planet, north of the equator. Since the telescope shows everything upside down, these maps (like all planetary drawings) were made likewise, the dark markings being styled collectively the "Southern seas," and the orange marking the "Northern con-

tinents." And at this period it was generally held that they did in fact represent seas and continents.

It will be seen that so far observers had not passed beyond fixing the general features of the planet, but the year 1877 marked the beginning of an amazing series of discoveries. Giovanni Schiaparelli, whilst making a trigonometrical survey of the Martian surface at the Milan observatory, observed on the bright regions or "continents" a number of streaks passing from point to point on the planet, and slightly darker than the general surface. These he called *canali*, which is the Italian for channels, but since the word canali was translated into canals, and instantly connected with artificial waterways, his discovery was met with more laughter than belief. Two years later, however, Schiaparelli again observed his original canali, together with many others. They now appeared straighter, and of a more precise and geometrical character than before; and at the next opposition, in 1881, not only was this tendency found to be more marked but, most surprising of all, some of the canali were seen to be double—there being in some instances two lines running parallel to each other, where previously there had only been one! Needless to say, Schiaparelli's critics still remained unimpressed. Since no other observer had as much as seen the markings, the seeing of double canali was only taken as further evidence that he was the victim of illusions, and for seven years little more was heard of the matter.

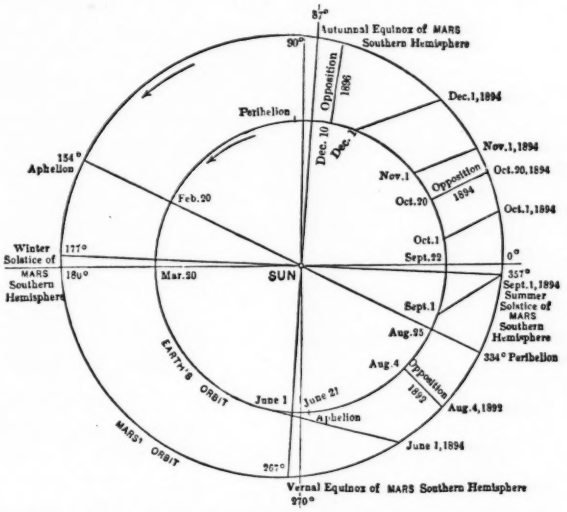


FIG. 1.—DIAGRAM OF THE ORBITS OF MARS AND THE EARTH (Lowell's Mars).

Confirmed.

But then, in 1888, the sceptics received a rude shock, for a number of other observers succeeded in seeing the canali—amongst others Mr. Stanley Williams using a 6½-inch telescope in England, M. Perrotin with the 30-inch telescope at Nice, and the Lick observers with their large 36-inch refractor. All these admitted to seeing some of the canali double; so, whatever the nature of the markings might be, that they had some objective existence could no longer be doubted.

So far all the canali observed had only been found on the bright orange coloured regions of the planet called the "continents," but in 1892 Professor Pickering in Arquipa made the most revolutionary discovery of all. He found that the canali were not restricted to the "continents," but that in some instances they extended to the supposed "seas," several of them being seen to cross the Mare Erythraeum, a sea in the middle of the map of the planet. By this time the subject had become one of great interest, not only to all planetary observers but to the general public, and with the object of devoting himself to a systematic study of the planet, Dr. Percival Lowell now founded an observatory at Flagstaff in Arizona, Mexico, the atmosphere in that part being probably the finest in the world for observation. His ardour was quickly rewarded; for he soon found that canali not only crossed the Mare Erythraeum, as Professor Pickering had stated, but that they crossed all the "seas," and that both in these regions and on the "continents" they were not only more numerous than had been supposed, but were finer, straighter, and of an altogether more geometrical nature generally. Since it seemed impossible that water could possibly give rise to the straight and unchangeable markings the canali were seen to be, it soon became evident that the "seas," whatever they might be, were certainly not seas, and Martian geography was thus completely upset.

Systematic Study.

From 24th May, 1894 to 3rd April, 1895, Lowell continued his first systematic study of the planet with his assistants Professor W. H. Pickering and Mr. A. E. Douglas, and the results were such as not only to provide quite a unique number of new facts about the planet's atmosphere and water supply, but to convince him that many of the markings were such that they could not possibly be explained by natural means alone. Indeed, as we shall see, he not only professed to have discovered a veritable network of canali all over the planet, but found that these, though permanent in

position, changed in development with the seasons, and concluded that they were probably the work of intelligent beings, intent on making the most of the melting snow caps at the poles for the purpose of irrigating the large desert area of the planet.

Air and Water on Mars.

So much for Martian discoveries in brief. Going on to the question of the possibilities of life on the planet, the issue is best divided into two questions; first, whether the conditions of the planet are such as to render any form of intelligent life possible; and, secondly, whether the nature of the canali and other markings observed give any indication of such life. With regard to the first point, we know well that there are two things absolutely essential to all forms of animal and vegetable life as known on this planet—air and water. What evidence have we of these on Mars? In the past it must be admitted, astronomers considered there was very little. Many of them held that, if Mars has any atmosphere at all, it must be much rarer than our own and contain little or no aqueous vapour; for not only was the planet found very free from obscuration by clouds, but, with its force of gravity being only one-third that of the earth, it was considered that the whole tendency of gases would be to escape into space, as is for the most part the case with the moon. Of more recent years, however, this opinion has been greatly changed. Not only at the Flagstaff observatory, but at a number of others, the strongest evidence of both air and water on Mars has been discovered, and this from a number of independent sources. In the main, of course, such evidence centres around the polecaps. These, as already seen, Herschel had held to be caps of snow similar to those on the earth, and this opinion, or at any rate that they are sheets of ice formed by continuous freezing of layers of dew, is now universally accepted.

Now in the Martian spring the polar snows are beginning to turn towards the sun, and it is then that the great melting sets in. According to the observations of Lowell during the opposition of 1894, on the 3rd of June (equivalent to 1st May on Mars) the south polar cap stretched over about 55 degrees of latitude, which would mean that it was about 2,035 miles across. It proceeded to decrease at the rate of about 100 square miles a day. As it melted a dark blue band appeared surrounding it on all sides, and became the most conspicuous marking on the disc. This band kept pace with the polar cap's retreat towards the pole, passing closer to the cap as it shrank. Further, not only did it conform to the cap in position—it did so in size, and by August it had become a barely discernible thread drawn round the tiny white pole patch, which was now all that was left of the enormous field of snow of a few months previous. From the fact that it was the colour of water, that it so persistently bordered the melting snow, and that it subsequently vanished, Lowell became convinced it was water. Others, however, doubted this, contending its blue appearance may be an illusion of contrast. But Professor W. H. Pickering examined it with a polar-scope, an instrument which distinguishes between a smooth surface of a liquid, and the rougher surface of a solid, and from the fact that it polarised, agreed that it must be liquid. It therefore seemed almost certain that it was a temporary polar sea formed around the melting cap, and disappearing as the water flowed down towards the equator of the planet.

Seasonal Changes and other Proofs of Atmosphere.

Having now found direct evidence of water, the next thing is to examine the changes of the permanent markings on the planet and consider what evidence these throw on the question of atmosphere. That there are changes in these, both as to their darkening and to a certain extent their colour, is almost universally accepted; but association of these changes with the seasons and more particularly the melting of the snow caps presents considerable difficulty, mainly owing to the short periods over which the planet can be effectually observed. Notwithstanding these difficulties, however, the steadily collected evidence shows that a great number of the changes, at any rate, are seasonal. From a careful consideration of the evidence revealed by all the observations prior to 1901, M. Flammarion held strongly to this opinion; and the evidence of the Flagstaff observers, if accepted in its entirety, is absolutely definite on the matter, not only with respect to the great majority of the changes in the large permanent markings, but even with respect to finer details like the smaller canals. Briefly summarised, the cycle of changes may be described as follows: When the snows of the summer pole have melted just after midsummer, the dusky markings around this area begin to darken. This darkening, moving in wave-like fashion, proceeds down towards the equator, until it has partly passed into the regions of the opposite (the winter) hemisphere; then, late in the autumn, the markings begin to fade, finally reaching their faintest soon after midwinter. According to Lowell, moreover, the change is not one in shade only, but also in colour. In parts, at any rate, with the summer months light green gives place to dark green; then, with the autumn, comes the brown, and finally the fading away shortly after midwinter. In view of such

evidence, it seems only reasonable to regard these permanent markings, once thought to be seas, as vast areas of vegetation standing out on their light desert background; and if this be so, as is generally agreed, it is clear that atmosphere must exist on the planet, for without it all forms of vegetation are impossible.

Martian Cloudscapes.

Moreover, of recent years there has been a great deal of evidence not only of mists and small white clouds (said by M. Jarry Desloges to be of daily occurrence), but also of giant clouds remaining over the surface of the planet for a considerable time. In 1911, for instance, a yellow cloud of eight million square miles stretched over the south pole of the planet, and in June 1922 Dr. Slipher at Flagstaff photographed a large white cloud that obscured a big part of the planet for over four days—surely very effective evidence of atmosphere. Again, Lowell furnished a quite independent proof in this respect. In measuring the diameter of the planet, both polar and equatorial, he found that the latter increased as the planet was viewed from a different angle—an illusion due to measuring a visible twilight such as an atmosphere gives rise to when at different angles to the sun and its observer. Lowell found, in short, that a process of side-lengthening took place; with the increase of the phase came an increase in the apparent size of the equatorial diameter, and this he held could be duly determined according to law. In this manner Lowell calculated the amount of twilight upon the planet visible from the earth to be about 10°, as compared with that of the earth which is 17° as seen from the earth; and from this and other calculations he concluded that the Martian atmosphere must be about one-seventh the density of our own—a figure, it should be noted, considerably lower than that given by more recent investigators, who place the atmospheric pressure of Mars as about one-fifth that of the earth. This, it is true, is a very thin air—so thin that no human being constituted as we are could live in it for a moment. But we must not conclude on this account that intelligent life is impossible on the planet. The study of evolution tends to show that life always adapts itself to its environment, provided the changes of the latter are not too rapid; and to argue from our own case that intelligent beings could not exist in an atmosphere such as the Martian is, as Flammarion so gaily expresses it, to argue not as a philosopher but a fish. There is nothing, so far as we know, to prevent a being with gills from being a very superior creature, and since all physical exertion on Mars would be minimised three-fold on account of the planet's gravity being only one-third that of the earth, the physical constitution of creatures living on it would not require to be changed to any extraordinary degree, even assuming them to have evolved in a manner very similar to ourselves.

From the above we see that the atmosphere of the planet, though very thin compared with our own, is at any rate not such as necessarily to exclude all possibility of intelligent life. With three-fifths of the planet desert, it is clear, however, that if such life exists, it must be greatly dependent for its water supply on the melting of the snow caps; and we must now go on to consider what evidence there is of the supposed arrangements for utilising these.

The So-called Canals.

This at once brings us to the so-called canals, about which there has been so much controversy, and here the first thing is to disentangle what is generally agreed upon from that which is so widely disputed. Dealing with the evidence concerning the canali generally accepted, the facts may be summarised as follows:—

(1) The canali run in continuous straight lines across both the "continents" and "seas," extending for hundreds, and in some cases thousands, of miles, with indifference to all other features on the planet.

(2) Their arrangement is such that not only do a number meet at a common junction after the fashion of railway lines, but, in the majority of cases, each one, when it has left the junction, joins a similar junction several hundred miles farther away.

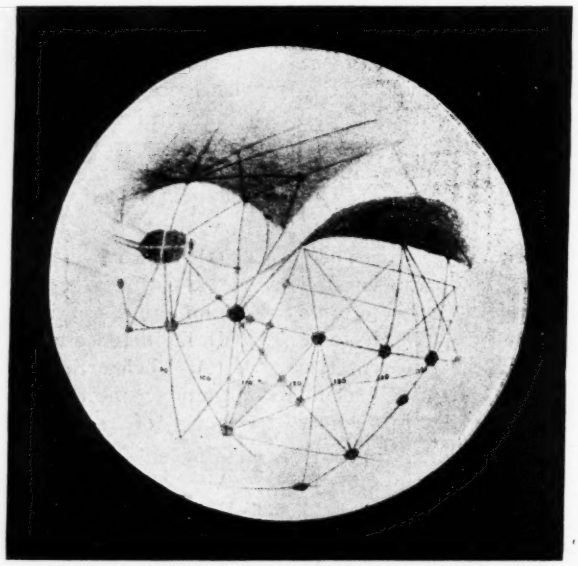
(3) They show a decided tendency to enter and leave the "seas" at bays and gulfs rather than at points along the straight coast, and are also, to a great extent, associated with the "seas" in that the two tend to darken simultaneously.

These facts are accepted by almost all observers; what is disputed, and very widely disputed, is the appearance of the canali—how far they are geometrical in their nature. At the one extreme we have the drawings of Lowell and his assistants at Flagstaff, representing them as a network of geometrical straight lines, much like railway lines as seen by the aviator; at the other are the drawings of M. Antoniadi, who, using the 33-inch telescope at Meudon, represented them as wide diffuse markings of a decidedly irregular character. The majority of observers stand midway between these two extremes. Though they show the lines as straight, their thickness varies enormously, and many of them become little more than blurs. "Why such differences?" it will be asked. The

answer in the main depends on three factors: the condition of the atmosphere, the size of the telescope, and the idiosyncrasies of different observer's sight

Limits of Vision.

Generally speaking, where the atmosphere is good the canali are seen much cleaner cut than where it is indifferent. Lowell, who at Flagstaff had the best atmosphere in the world, drew them as considerably sharper than any of the other observers, and it is noticeable that the astronomers who agreed with him most closely were M. Jarry Desloges and V. Fournier, who at Le Massegros, Lozere, had an atmosphere second only to Lowell's at Flagstaff. But, on the other hand, it is pointed out that all these observers used comparatively small telescopes, and M. Antoniadi, who worked with the 33-inch telescope at Meudon, contended that, had Lowell used an instrument as big as his, he would have found that the features that appeared to him sharp would have assumed a much more diffuse and irregular character. No doubt many people would be inclined to agree with Antoniadi, for it is generally imagined that the bigger telescopes must always give an advantage. But the truth is, with planetary observation this is only true up to a certain point. The size of aperture that can be effectively used for this purpose mainly depends on the atmosphere. Above a certain range, it is found that in quite good atmospheres big telescopes do not show planetary detail any better than smaller ones, and in all cases to have a telescope bigger than the conditon of the air permits is a great disadvantage. Indeed, even Lowell, who had the best atmosphere in the world, found that he could rarely use more than 12 or 15 inches of his 24-inch aperture; so, with perfection of atmosphere and *quality* of instrument as two main essentials for the work in question, it is clear that his results, whatever their merit, are not to be dismissed merely because they differ from those of observers using bigger instruments.



MARS. LONGITUDE 180° ON THE MERIDIAN.
(Lowell's Mars).

As previously stated, Lowell not only drew the canali as of a more geometrical nature than most of the other observers, but also showed more of them. On the regions visible in the opposition of '94, for instance, he observed in all 183, as compared with the 79 observed by Schiaparelli in the same region; and the majority of these he professed to have seen many times over. In length the average was calculated to be about 1,500 miles, and the longest 3,540 miles; whilst their thickness in all cases he placed at a little less than a Martian degree, which is about 30 miles.

The Canali as Interpreted by Lowell.

Certainly the canali as drawn by Lowell present a most artificial appearance. Not only do they go with wonderful straightness to their points of intersection, but 3, 4, 5 and even 7 will meet at the same spot, and the whole presents a strangely systematic network. Moreover, there is another most significant fact about the system, namely, its growth with the seasons. According to Lowell, this is a well-established fact. Though in position the canali remain fixed, not changing from one opposition to another, they are amongst the most changeable features of the Martian disc. From invisibility they emerge for some reason inherent in themselves into conspicuousness, and their changes synchronize with the change in the Martian seasons. Not until the melting of the polar snows has considerably progressed do they become perceptible; then those nearest the melting area come first, and, having once become visible, they remain so, gradually growing darker as the season advances; whilst in the meantime those in lower portions of the disc appear, and continue to do likewise, until by October, the canali have extended to the other extreme of the planet.

How can such a system as this be explained on natural lines alone? That they cannot be rivers or mountain ranges is clear enough. Of the suggested natural explanations the most plausible is that they

are cracks in the surface produced by volcanic action. But this, though explaining their straightness and radiation from a centre hub, does not account for their extraordinary length, nor for why they converge so perfectly at other centres. No doubt it is easy to show that, under certain conditions, all sorts of configurations can be made to appear geometrical; it has been shown, for instance, that a haphazard distribution of spots will in itself produce this effect when viewed sufficiently far off. But even admitting the force of such arguments, they are by no means adequate to explain the canali as drawn by Lowell and even many other observers, and we have to admit that as yet they constitute a problem completely unexplained. The explanation furnished by Lowell is certainly the most plausible to date. He held that they are artificial waterways cut all over the planet for the purpose of irrigation, and that the lines we see are not the waterways themselves but areas of vegetation growing on each side of them. With the greater part of the planet desert, he pointed out that, if any form of intelligent life did exist on Mars, its whole effort would be concentrated on making the most of the limited water supply, and his contention was that the canals were used for feeding the dark circular spots at their junctions, which he held to be a number of oases stretching across the desert areas. His observations showed that these spots, varying from about 120 to 150 miles in diameter, were in no cases found unattended by canali, also that they darkened in harmony with the latter; and he contended that not only was this theory subject to no serious objection, but that by accepting it we could explain all the phenomena observed in the most consistent possible manner.

Doubt.

That the theory explains all the phenomena observed is no doubt true; but it has to be remembered that a theory postulating intelligence can explain almost any phenomena observed, and in many respects such reasoning is not unlike that of the savage, who, unable to find the next steps in the causal chain of phenomena, as does the scientist, calls in a different deity to account for almost every effect he sees. Nor, again, must it be forgotten that a big part of the evidence on which the theory is based is taken from Lowell's own drawings. which differ considerably from those of the great majority of observers; hence, all things considered, it becomes clear that, until such evidence is more completely supported by observations at the present and future oppositions, it would be idle to accept the theory as anything more than an interesting piece of speculation, and astronomers as a whole certainly do no more.

Not that this attitude implies any pre-Copernican vanity. In the light of modern science no philosopher could reasonably believe that the universe exists merely for the handful of beings on this earth. If astronomy has shown us anything, it is that no possible language of ours can ever express the infinitesimal nature of our planet, and, indeed, our whole solar system, as compared with the myriads of other worlds we see around us; and if, as the majority of the greatest philosophers have held, the soundest interpretation of the universe is a teleological one, then it would be absurd to regard ourselves as more than some tiny link in the telos. That myriads of other suns may have solar systems very similar to our own seems as reasonably possible as anything unobserved can be possible; but with such possible systems necessarily outside the scope of our senses, our search for life must always remain restricted to our own little solar system. Of the planets constituting this, Venus and Mars are the only two where life in any form such as we know it seems at all possible, and Venus is certainly the more likely of the two. Unfortunately, however, the dense layer of clouds that envelop this planet defies all observation of its surface, and so it is that mankind has turned to Mars—and doubtless will continue to turn to it throughout this and future oppositions.

NAPHTHALINE MOTORS.

A QUARTER of a century ago naphthaline or "camphine" lamps were used. In these the naphthaline was melted in a reservoir and thence fed to a burner. To-day, the same principle is being revived in France and crude naphthaline is being applied as a motor fuel.

The engine having been started on petrol, the exhaust heat is used to liquify and vaporise the naphthaline which is then allowed to flow to a hot jacketed carburettor of the usual type. The mixture of air and naphthaline vapour functions well, giving an easy somewhat slow explosion. Despite this it does as well in high-speed high-compression engines as in large-capacity low-efficiency motors. The cost of running is approximately ten centimes per hour—roughly one farthing.

The old trouble with naphthaline lamps was the choking of the tubes with condensed crystals when the apparatus was cold. It is probable that similar troubles will have to be overcome with any naphthaline carburettor evolved for use with internal combustion engines.

The Vorticella or Bell-animalcule.

By Sir Arthur E. Shipley, G.B.E., F.R.S.,
Master of Christ's College, Cambridge.

At this time of year the Bell Animalcules can be found in almost every pond. They are one of the most beautiful and interesting of pond-life objects and their method of reproduction can be watched under the lens.

ANOTHER unicellular animal, and therefore a Protozoon, is frequently found in vegetable infusions such as stagnant water and may be very commonly seen on the roots of duckweed. If you take some hay or dead leaves and soak them in soft water, and leave them to stand for a time, the Bell-animalcules are almost certain to turn up in the infusion. After the hay and the leaves have decayed, a brown scum forms on the surface and on the underside of this numerous specimens are to be found. These are just visible to the naked eye, and scientifically are called *Vorticellae.* Like the Slipper Animalcule, they occur both in fresh-water pools and streams and in the sea. One species of them, the *V. monilata,* is easily recognized, because it has little knobs or warts, rather like the rivets which hold metal plates together, all over its body.

Fixed Anchorage.

Vorticella differs fundamentally from the Slipper Animalcule in that it is anchored. It is shaped something like a bluebell flower or a bell with a long stalk or handle, and the lower end of this stalk is anchored either to the roots of the duckweed, or to some other fixed point. The bell however, is not hollow. It is solid and contains the chief organs of the body. Closing the bell is a flat circular structure, ringed about with cilia, called the disk; and between the disk and the edge of the bell, which has a similar row of cilia, is a groove. At one point of this groove it deepens into a funnel, at the bottom of which lies the mouth. A *Vorticella* may live apart from its fellows, or they may be crowded together. But even then they are quite separate and have no organic communication with their fellows. But there are other unicellular animals whose structure closely resembles theirs, which are branched like fluffy feathers and these indeed form colonies, all the individuals being in organic connexion with one another. In *Paramoecium* the cilia are scattered in more or less regular rows all over the body, but in *Vorticella* they are confined to the rings already mentioned. But they run down towards the mouth opening, which also supports a triangular flap which is said to take some part in bringing food to the mouth. Acting in unison, the action of these cilia produce a vortex (which is Latin for whirlpool), and by their action food particles are drawn towards the mouth, fresh oxygenated water is brought into the neighbourhood of the animal, which breathes all over its surface, and the excreta are washed away. The shape of the animal is permanent, and this is due to the fact that it is surrounded on all sides by a firm cuticle which, however, becomes much more firm and more thick in the region of the stalk. Under the cuticle we have a thickish layer of protoplasm called the ectoplasm, and this in turn surrounds a thinner more watery mass of protoplasm known as the endoplasm, which constitutes the great bulk of the body.

Corkscrew Action.

If we look carefully through a high-powered lens at the body of the *Vorticella,* we shall be able to distinguish certain fine stripes or striae which converge towards the top of the stalk. Here they get together and form a small definite organ, a muscular strand. This strand is attached to the inside of the cuticle of the stalk at short intervals, and in such a way that when it contracts it throws the stalk into a corkscrew-like spiral and the body is suddenly drawn down, it is jerked out of position and is brought down near to the base of the stalk. Should an enemy approach the *Vorticella* with a view of eating it, it suddenly contracts the muscle in the stalk, swiftly changes its position and thus escapes destruction. The jerking is very quick and sudden. At the same time the disk is also withdrawn into the centre of the groove, and the edges of the groove fold over it. Thus the body is reduced to the shape of a sphere, protected on all sides by the hardened cuticle. After the danger has passed the muscle relaxes and by the elasticity of the cuticle the stalk straightens itself out again.

Inside the body of the Bell Animalcule are many food-vacuoles which traverse a more or less permanent path through the soft protoplasm until the food contents have been digested. The indigestible parts are then ejected at a certain definite spot which closes up immediately after the expulsion of the waste matter, and is not seen again until the next food-vacuole yields

up its insoluble contents. A very convenient way of tracing the path of the food is to grind up a little Indian ink in the water in which the *Vorticella* lives. Little particles of sepia which form the Indian ink are caught into the whirlpool, carried to the mouth, and passed round the body quite black and undigested to the spot where they are finally ejected. Besides the food-vacuoles the *Vorticella* has a contractile-vacuole which gets bigger and bigger until it suddenly collapses. This is believed to excrete waste nitrogenous matter of some kind.

Reproduction.

Like the Slipper-animalcule, *Vorticella* has a large nucleus (mega-nucleus) and a small nucleus (micro-nucleus). The first is an elongated rod curved somewhat in the manner of a horseshoe. Both take up stains more readily than the surrounding protoplasm (this is especially true of the mega-nucleus) and both exercise a control over the single cell which forms the body and stalk of the animal and play a large part in reproduction.

Vorticella reproduces by longitudinal division. The disk and the ciliated groove contract and a transverse depression appears, which deepens and forms a cleft which ultimately splits the body in two. Both micro- and mega-nucleus become dumb-bell shaped and ultimately divide into two halves. For a time the cleft does not reach the stalk, so that we have two bodies supported by the same stalk. One of these will now form an additional circle of cilia at the end near its attachment. It then becomes detached and swims away on its "lawful occasions."

It may now settle down, lose its hinder circle of cilia, develop a stalk, and grow up to be a complete *Vorticella*. Since one form remains on the stalk and one starts out to explore the world, one may here see the first glimmer of parent and child. But this division will not go on indefinitely. For three or four days *Vorticella* will flourish and multiply in an organic solution, but then unless conjugation takes place, the whole community dwindles and finally disappears. In conjugation we find two forms taking part: first the macro-gametes, which are stalked, typical, normal *Vorticellae*; secondly, the micro-gametes, which, as the term indicates, are smaller; they have a posterior ring of cilia by means of which they swim freely, and, of course, they have no stalk. These forms are brought about, as we have described above, by the division of the ordinary stalked form. One of the micro-gametes will now approach a stalked form and begin to fuse with it. This it usually does about dawn, and the whole process lasts thirteen or fourteen hours. It pushes its posterior half into that part of the stalked form which is near the commencement of the stalk. Its micro-nucleus now divides into two and it loses its posterior circle of cilia. When fusion is complete, the smaller nuclei of both divide and then divide again, the result being that in the macro-gamete there are four micro-nuclei and in the micro-gamete eight. Seven of the eight now disappear, and three of the four similarly vanish; the remaining two now come into contact, and immediately divide again. Two of these disappear and the two remaining may be

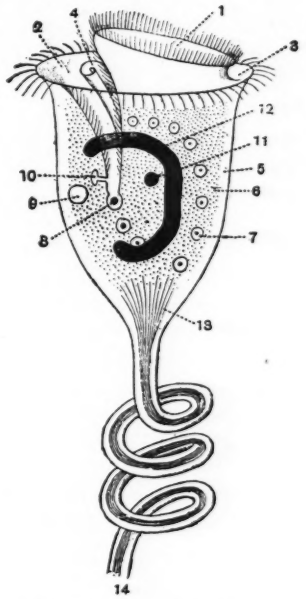


DIAGRAM OF VORTICELLA.
The Cilia at the side of the Mouth have been omitted.
1. Disc. 2. Mouth. 3. Peristomial groove. 4. Vibratile membrane in mouth 5. Cortical layer. 6. Endoplasm. 7. Food-vacuoles. The last of the food vacuoles is nearing the position of the anus. 8. Pharynx, showing formation of food-vacuoles. 9. Contractile vacuole. 10. Permanent receptable into which the contractile vacuole opens. 11. Micro-nucleus. 12. Mega-nucleus. 13. Contractile fibrils running into muscle in stalk. 14. Stalk contracted (the axial fibre should touch the cuticle in places).

regarded one as the male and the other as the female nucleus. They fuse together and form the nucleus of the combined *Vorticella*, i.e., the result of the fusion of the movable micro-gamete and the fixed macro-gamete.

We have in these processes a forerunner of sexual reproduction, and it is important to bear in mind that, whereas in the case of the Slipper Animalcule the two conjugating organisms are of the same size and of the same shape, in *Vorticella* we have one small movable organism which fuses with—one might almost say fertilizes—a fixed form of quite another shape and size. The active micro-gamete, in fact, acts as a male, the passive macro-gamete as a female.

Poisonous Insects of the English Countryside.

By Owen B. Lean, B.Sc., F.E.S.

Illustrated by D. E. Kimmins.

Few things cause more irritation on a holiday than insect bites. If you are a sufferer this article may help you to identify your assailant.

To many people the joys of the countryside, during the summer months, are completely marred by the persistent attentions of small and inconspicuous insects. And, although we are all attacked to a greater or lesser extent, there can be no one, who, at one time or another, has not been so pestered that he has been compelled to retire indoors from his comfortable deck chair on the lawn or who has had to escape from the shade and shelter of some trees where these insects abound. Wasps have always been the cause of excitement and terror at the table, whether within or out of doors; midges, though less spectacular, cause the dissolution of many picnic parties and afternoon siestas; whilst the objectionable little red Harvest Bug that burrows into our skin, especially at the ankle and knee, causes far more irritation than that notorious household insect that is so seldom seen and yet less seldom mentioned. But the average country rambler knows nothing of the insects that vex him. He knows nothing of their appearance, of their life-history, the manner in which they attack him or even of any means at his disposal to prevent or allay the effects of those attacks. It is therefore the intention of the present article to give some of the known facts of the habits and structure of these noxious insects, which may interest the sufferer, and they are written with the hope that knowing the cause of the trouble may alleviate, to some extent, the pain which we must all endure.

The Midge.

The most universal and probably the most annoying of these insects is the midge. It is found everywhere where there is shade; in the garden, on the river or in the woods it is equally troublesome. All midges, however, do not suck blood and it is only the members of the genus Ceratopogon, of which we have some fifty or more in this country, that have developed this habit. The midges are the smallest of the blood-sucking flies and as their bodies are hardly ever more than two millimetres in length, they usually remain unseen. Like all true flies they possess only one pair of wings, which in many of the species are densely covered with minute hairs. The sexes are easily differentiated by the fact that the males have their antennae much more tufted than those of the females. If a large number of Ceratopogon be collected and examined, it will be found that the males are distinctly in the minority and those males that are present are quite harmless, as it is the female sex only which has acquired the blood-sucking habit.

These midges are always more in evidence during hot, still, damp evenings and it is at such times that the females are most prone to bite us. In performing this operation the sharp needle-like mouth parts are driven through the skin, a little saliva is then pumped into the wound, probably in order to reduce the surface tension of the blood fluid so that it may the more readily be sucked up through the fine channels of the proboscis. If a midge be observed whilst in the act of sucking, and be allowed to complete its meal, the abdomen is seen to become distended and tinged with the red of the blood. The result of the midge attack is too familiar to require description, but the fact that the seriousness of the bite varies enormously with the condition of the individual attacked and with the season is worthy of note. Ceratopogon will attack man wherever the flesh is exposed and wherever the clothing can be penetrated—one of the most frequent spots being around the ankles.

FIG. 1.—FEMALE CERATOPOGON OR MIDGE.

The various species of Ceratopogon occur throughout the summer; their attacks begin in April or May and last well on into September. The female deposits her eggs in batches of about a hundred, either on the surface of water or in some damp situation, such as under loose bark or on decaying vegetation or manure. The larvae are vermiform and move with a serpentine motion. After a short time they become quiescent and turn into pupae from which the flies duly emerge to enjoy but a brief existence including a feast or two of human blood.

Mosquitoes.

Closely related to the midges are the mosquitoes. The terms mosquito and gnat are quite synonomous, but many of the smaller mosquitoes are frequently referred to as midges. In this country two genera are of most importance—Culex and Anopheles—the latter so inseparably connected with the dreaded malaria fever, that few people realise that Anopheles maculipennis, one of the main carriers of the fever in South Europe and America, is indigenous to and even very common in parts of Great Britain. In all stages of their life histories the members of these two genera may readily be distinguished.

Both Anopheles maculipennis and Culex pipiens, the common gnat, lay their eggs on the surface of water. Those of Anopheles are laid singly and usually come to lie on the surface in starlike groups, whilst those of Culex are laid in raftlike masses of some 400 eggs. All the larvae are aquatic, but may be either herbivorous or carnivorous. The Anopheles larva, when at rest under the surface film of the water, rests with the main axis of the body parallel to the surface, whilst the Culex larva rests at an angle of about 45° to the surface. The pupae, which are active but which do not feed, are characterised by the large globular cephalothorax and comparatively slender abdomen; that of Culex hangs vertically from the surface, whilst that of Anopheles is inclined at an angle of about 45° to the surface. The adult mosquitoes are best differentiated when at rest. The body of Anopheles is usually inclined at an angle to the surface on which it stands, with the head down, whilst Culex rests with the abdomen parallel to the surface. On careful examination the structure of the mouth parts is seen to differ in the two genera. In Anopheles the palps are as long as the proboscis and in Culex they are very short and inconspicuous. As in Ceratopogon the sexes may be differentiated by the fact that the males possess plumose antennae, and as in Ceratopogon the blood-sucking habit is confined to the female sex.

The mouth parts of mosquitoes are complicated organs. The proboscis, lying between the two palps, consists actually of seven structures. Within a sheath formed by the lower lip (labium) lie the upper lip (labrum+epipharynx), the hypopharynx and two pairs of stylets—the mandibles and maxillae. When a female feeds she pierces the skin with the stylets, then as the rest of the mouthparts are driven into the flesh, the lower lip is doubled back. Saliva is now passed down the hypopharynx into the wound and with the saliva passes a certain amount of the contents of the insect's oesophagus, which contains a fungus and it is this fungus that causes the extreme irritation and swelling. The mosquito then sucks the blood up through the channel formed by the upper lip and hypopharynx.

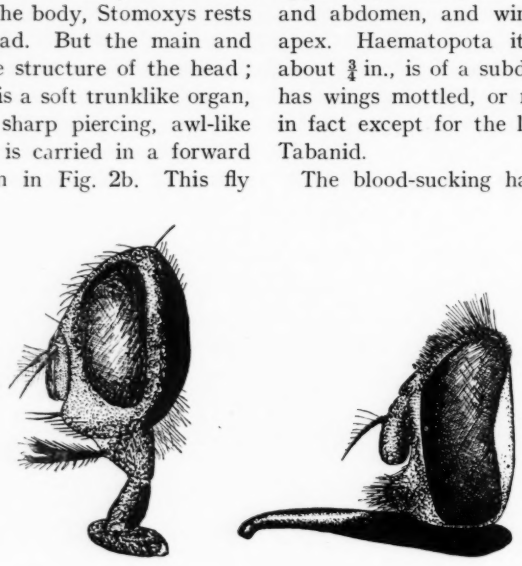
Mosquitoes are found in practically every locality, though especially where there are good breeding grounds in the form of water troughs, rain-water tanks and so on. But in addition these insects are attracted to a bright source of light and consequently enter the house at night and disturb our slumbers by buzzing around the room. This buzzing is not formed so much by the vibration of the wing as a whole, as is usually supposed, but rather by the rubbing together of two ridges at the base of the wing, whenever the wing is caused to move. That the buzzing sound is not simply an accidental accessory to flight is shown by the definite stridulating organ that causes it and by the fact that male mosquitoes may be attracted to instruments emitting a note with a certain number of vibrations per second, a note which seems to resemble the buzz of the female.

The Cure.

Once these insects have bitten, little can be done to prevent the irritation, though any cooling lotion or any of the commercial insect creams do lessen the pain by cooling down the inflamed tissues. But prevention is better than cure, and the attacks of midges and mosquitoes are best warded off by treating any part of the body that may suffer with some heavy essential oil, which, though it may be none too pleasant in itself, will act as a repellent, not only to the blood-sucking flies, but also to those swarms of more harmless flies that annoy by buzzing around the head. A chemical has yet to be discovered which will act as an effective repellent to these insects and which at the same time cannot be detected by the imperfect human olfactory organs. One mixture that can, however, be recommended is: 1 oz. oil of citronelle, 1 oz. spirits of camphor, with ½ oz. oil of cedar. Tobacco smoke is another useful repellent and a few cigarettes or a pipe will soon clear the air of all insect life. The usual country method is to drape one's hat with a frond o

bracken, but within the writer's experience this is totally ineffective.

Then there is Stomoxys, the stable fly or the biting housefly. This insect is so similar to the ordinary housefly—Musca domestica—that the entomologist frequently has great difficulty in maintaining that the housefly does not and cannot bite. The markings on the body are slightly different from those of the housefly and whereas the latter usually rests with the wings closely applied to the body, Stomoxys rests with the wings slightly spread. But the main and important difference is in the structure of the head; the proboscis of the housefly is a soft trunklike organ, but that of Stomoxys is a sharp piercing, awl-like organ, which when at rest, is carried in a forward position, as is clearly shown in Fig. 2b. This fly frequents open spaces and only occasionally penetrates within the house; its most usual habitat is in the vicinity of stables and cowsheds. Its painful bite is simply a piercing of the skin, followed by a sucking of the blood. Stomoxys calcitrans, the only European species of the genus, is not the carrier of disease in this country so far as is known, but it is of especial interest in this connection because it is a close relation of the notorious Tsetse Fly—Glossina morsitans—the most common carrier of sleeping sickness in Central Africa.



(a) (b)

FIG. 2.—(a) HEAD OF MUSCA DOMESTICA OR HOUSE FLY x 14.
(b) HEAD OF STOMOXYS OR BITING STABLE FLY x 14.
Note the pointed proboscis of the latter

The life history of Stomoxys is simple and typical of the family Muscidae. The eggs are laid and the maggots live in farmyard manure or decaying vegetable matter. Pupation takes place some depth below the surface. After the adult fly has emerged from the puparium it makes its way upwards to the surface. It forces its way through the manure by alternative inflations and deflations of the ptilinum, which is a balloon-like organ, normally inverted within the front of the head.

Horse Flies.

More familiar are the attacks of the Tabanidae, named in various parts of the country, horse flies, breeze flies, gad flies, clegs or stouts. A large horse fly, which may measure nearly two inches across the wings, is an insect which is feared not only by humans but also by the cattle, who know the loud drone of such as Tabanus bovinus only too well. The English Tabanids vary greatly in size from the immense T. sudeticus to the lesser, though still formidable, Haematopota and Chrysops. Fortunately, these latter genera contain the common horse flies of the countryside and Haematopota especially is likely to be encountered. All the horse flies are heavy bodied with a flattish head, short, thick, many-jointed, though apparently three jointed antennae, a squarish thorax and abdomen, and wings somewhat pointed at the apex. Haematopota itself has a wing expanse of about ¾ in., is of a subdued greyish brown colour and has wings mottled, or marked with dull grey bands, in fact except for the latter character it is a typical Tabanid.

The blood-sucking habit is again confined to the female sex, and the females may be distinguished from their inoffensive mates by the large compound eyes which are separate in the females, but which meet along the top of the head in the males. The harmless sex feeds on flowers or any similar vegetarian diet which even the thirsty female will not scorn when her proper food is unobtainable. The proboscis is a prominent organ made up of the full complement of instruments as employed by the mosquito. When the insect settles on its prey it slashes through the skin with its sharp mandibles and then sucks up the blood that is caused to flow. Beyond the simple wound there are no complications and even in the tropics Tabanids have not, as yet, been condemned as disease transmitters.

The favourite hunting-ground of Haematopota is the edge of some wood, though they may be found anywhere in the fields, in lanes or clearings of woods. They are active on any clear warm day from June to August and are especially troublesome about midday. Frequently one may feel an insect on one's neck or on the cheek and then before there is time to raise the hand, there is suddenly a short sharp pain, a short pause, and the insect is gone; and it is during that brief pause while the insect is sucking up the blood, that she is best captured.

The larvae of Tabanidae generally are rarely met with. They live in a variety of situations such as the

rich, rotting soil at the edge of ponds and streams, in rotting wood or even swimming about in the water. Practically all are carnivorous, feeding on each other, on other insect larvae, worms or any obtainable animal matter.

Not to be confused with the Tabanidae are the Syrphidae, that family of brightly coloured flies popularly known as hover flies. Hovering apparently motionless in the air, suddenly darting away with such speed that they are lost to human sight, only to reappear a few feet away, hovering again, they are familiar objects in the garden where they may also be observed at rest on some flower, displaying their gaudy black and yellow bodies. Other species, the drone flies, closely resemble the honey bee. But they are all harmless; their exact food remains as yet unknown, and though they apparently feed on pollen to some extent, it is possible that they may be beneficial in preying upon small midges and similar insects.

FIG. 3.—TABANIDA HAEMATOPOTA OR HORSE FLY.

The Wasp.

I suppose the most uncomfortable pest of the garden is the wasp. Although the bees are more abundant and have a longer season of activity, there is little need to get stung by them, unless one is an apiarist, and then one becomes so hardened that the stinging is of little matter. The wasps, and in fact all the Hymenoptera, differ in the purpose of their attacks from the flies that have been considered. Whereas the flies prey upon man for the sake of his blood, which is their staple food, the wasp's attacks are purely defensive and he will do no harm at all unless disturbed during the business of food getting.

It must always be remembered that the wasp is as much a beneficial insect as it is a pest. When the queens awaken from their all-winter sleep, they slowly build up their large families and as the family increases the food problem becomes more and more acute. All the developing grubs within the nest have to be fed on fresh animal matter, and for this purpose the workers scour the neighbourhood in search of caterpillars, flies and what not. In this manner they serve as a really efficient check on the numbers of the housefly, and anything, whatever it may be, that does keep down the numbers of the housefly must be recognised and treated as a beneficial insect. But later in the year, early in August, the status of the wasp alters. A change comes over the inhabitants of the nest, the workers forego their altruism, they have had enough of feeding their brethren on dismembered flies, and their main object is now to obtain food for themselves, and as they choose food that is to the human liking the result may be disastrous. This is the time when the wasp is a real pest, feeding on the jam, drowning in the honey, and destroying all the ripe fruit that remains on the trees. Only at this time are the wasps really in evidence and really liable to sting. Promoters of children's competitions where prizes are given to the collector of the greatest number of queen wasps, must realise that this wholesale slaughter acts both ways. There may be less wasps, but just as certainly there will be a correspondingly greater number of flies, which are after all the more serious pest.

Stings.

Compared with the bite of a mosquito, the sting of a wasp or a bee is a simple operation. The puncture is made by the two sawlike instruments which work within a sheath and the poison is ejected into the wound from a sac within the abdomen where the poison is stored until required. The saws of the wasp are only slightly barbed, whilst those of the bee are so strongly barbed that the bee is unable to withdraw its sting from the human skin and has perforce to tear it out of its own body—an act which causes its ultimate death.

The old-time remedy of applying the blue bag—a mixture of indigo and starch—to the wound, is effective to some extent, though the prompt application of ammonia is a more sure remedy. With juvenile patients, perhaps the blue bag may be the better cure, for some timely autosuggestion is a good substitute for any specific antidote.

The Wood Ant.

Turning now to the woods we encounter the wood ant, Formica rufa, another very troublesome Hymenopteron. It is one of the most fascinating of British insects, and any amount of time and trouble spent in the study of its habits will be amply repaid. It is

the largest and most formidable of the ants of this country, and, forming as it does the largest nests, it is well known to the observant country rambler. Throughout the country, wherever there are coniferous woods, the great mound-shaped nests are common objects and the ground seems alive with scurrying ants, all apparently bent on some important mission. The nests, which may be two or three feet in height and twice as many feet in diameter, appear to consist of a heterogeneous mass of broken twigs and ants, with the latter predominating on the shady side of the mound or wherever a shadow is cast by some overhanging branch. In this shadow the ants congregate in masses which may be an inch or so in thickness; these are apparently the workers whose labours are over for the time being, and there they rest while another shift carries on the endless task of bringing in the food for the grubs and of repairing and extending the great communal dwelling. There is as much law and order in the division of labour as there actually is in the architecture of the nest. This is no mere heap of broken twigs, but a structure built on a definite plan, with galleries, passages, nurseries, entrances and exits all defined. And the nest is not only that mound that is visible, but it extends into the ground, forming a subterranean nest as great as that above the surface.

Poison Squirters.

All the ants that are so busy, frequently carrying twigs twice the size of their own bodies, are the workers. For the individuals that make up an ant community are of three castes. First and all-important is the queen. She lives in the centre of the nest, never stirring without the well-defined walls of her palace, vigilantly protected by a host of workers who feed her and carry her below the ground as soon as the nest is disturbed. Her business is to lay eggs and beyond that she does nothing. Secondly there are the males which only appear spasmodically. The normal Formica rufa nest contains no males. At intervals only are they produced and like the freshly emerged queens they possess two pairs of wings. Their existence is very brief, for after a short nuptual flight they fall to the ground and die. The queen on the other hand drops to the ground, looses her wings and builds up a fresh colony. The workers are actually of the female sex, though functionally asexual.

The queen lays her eggs and the workers immediately transport them to the breeding chambers where they are stored in masses. The eggs are very minute and must not be confused with the commercial "ants' eggs," used to feed goldfish and birds, and which are in reality the cocoons containing the pupae of the ants. But the workers do not leave the eggs uncared for. They are being continually moved about and turned over so that they may all be acted on by the same climatic conditions. And the masses of eggs are always being transported from one chamber to another, according to the changes in temperature, humidity and so on. The grubs are helpless and are carefully nourished by the workers who feed them on partly digested food, regurgitated from their own stomachs. The maggots finally spin the well-known

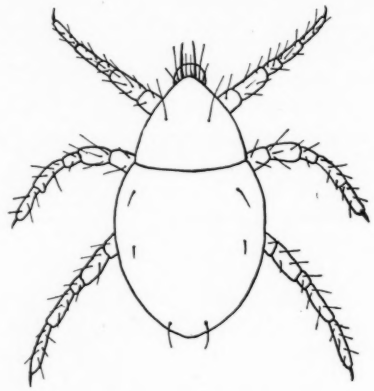


FIG. 4.—HARVEST BUG OR MITE.

white cocoons within which they change into pupae, and from which the adult ants emerge after a short period. Both larvae and pupae are carried about within the nest in conformity with any change in climate.

The workers are extraordinarily active and will attack at the slightest molestation. Touch the top of the nest with a twig and in a moment a dozen or more of these long-legged creatures will be up the twig and on to the hand; there they attempt to bite a small wound in the skin with their powerful enlarged mandibles, which are easily visible. If they are able to pierce the skin, which is only possible when it is very tender, they double up the abdomen and squirt a fine jet of poison into the incision. Again, if the open palm be placed over the surface of the nest where the workers have congregated, there is immediate pandemonium. The ants sit up almost vertically with their legs sprawled out and with the tip of the abdomen upturned and from its apex they eject a fine jet of formic acid onto the offending hand. But on the hand the poison can hardly be felt, though on the face it causes a burning sensation that may last five to ten minutes. It is very fascinating indeed to watch an annoyed ant suddenly sit bolt upright and squirt the poison some six inches into the air. The atmo-

sphere around a disturbed nest soon becomes tainted with the characteristic odour of the acid.

In an ant-infested locality it is almost impossible to keep free of them. They are present everywhere, they drop down from the branches where they have been seeking aphides and they crawl up the legs if you stand still. Yet, though a swarm of ants crawling about one's person may be somewhat disconcerting, there is really very little chance of anything more than a few quite harmless bites.

To find the queen the bites must be totally ignored. An unmolested nest should be approached with care and before the workers have time to suspect an attack, the hand should be plunged into the heart of the nest which is then spread out, and if you are quick enough the queen will be found before the workers have rushed her down to the cellars. She is easily distinguished by her large size, her large, shiny, globular abdomen, and by her black and much more massive thorax.

The Harvest Mite.

Mites are not, of course, insects; for whereas the normal adult insect possesses three pairs of legs, the adult mite is furnished with four. But the fact that the harvest mite, being a young stage, possesses only three pairs is made the excuse for discussing it here with the poisonous insects.

The harvest mite is distinctly one of the major personal pests of the countryside, and one that may make open-air life quite intolerable. The adult, known as Trombidium, wanders about feeding on small insects, and the nymphs normally feed parasitically on small invertebrates, especially caterpillars, and only accidently penetrate the human skin, and as this food is not normal they do not live for long. Temporary though it may be, the presence of these mites burrowing in the skin is distinctly unpleasant and causes extreme irritation. Cases of superabundance have been known where it has been impossible for the farm workers to enter certain fields. Preventive treatment is fortunately simple, though generally unknown. Sulphur is a specific poison to all mites, and by treating parts of the body that may become affected with a sulphur ointment or by bathing in water containing flowers of sulphur, the skin is made unattractive to the mite.

It is to be hoped that in the future much work may be done towards discovering fresh and more sure repellents against the attacks of all poisonous insects. In England insects are little more than an annoyance, great though it may be, but in warmer climates an insect bite may be a matter of life and death. Such a repellent as sulphur against mite is one of the surest known, but although such remedies are not known against all insects, much can be done to reduce the acuteness of their attack.

THE APPEAL FUND.

THE Trustees beg to acknowledge with thanks the following subscriptions in addition to those already recorded :—

	£	s.	d.
Allen C. Harris (2 subscriptions) ...	62	0	0
The Thos. Wall Trust	25	0	0
Cyril Crossland (2nd donation) ...	8	4	0
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In the last number the name of Mr. E. Fiddes should have been so printed as the donor of £1 1s.

Since this list will be seen by many who have not read the Appeal which the Trustees issued in April last, they think it well to state again that the Fund is being raised wholly to meet the liabilities incurred during the period of transition and the administrative expenses of the Committee for a period of three years; thereafter the Trustees believe that these expenses will be covered by the contingent allowance reserved to them under their agreement with Messrs. Benn Bros. Ltd., who have undertaken the whole cost of publication.

The Committee's work is to organise the voluntary help of eminent specialists, to whom the articles are submitted for verification.

R. S. Conway, *Hon. Secretary,*

C. H. K. Marten, *Hon. Treasurer to the Managing Committee.*

THE BEETLE MYSTERY.

THE reported success of the Austrian scientist, Dr. Finkler, who was said to have successfully transplanted the heads of water-beetles to different bodies, now seems to be rather dubious.

The experiments, or rather the account of them, attracted a great deal of attention at the time, and many biologists endeavoured to repeat them. So far, states a correspondent in a letter to *Nature*, only one experimenter, besides the original discoverer, claims to have succeeded in repeating this success.

Others have asked the original discoverer to produce his grafted beetles, alive or dead, and he has not done so. The scientific world is decidedly puzzled, and at length some German research workers of undoubted standing have published a challenge to Dr. Finkler which cannot be ignored by him.

The Bacteriophage

By Dr. Igor N. Asheshov.

The Bacteriophage is one of the latest and most important discoveries in bacteriology. There are it appears, bacteria which destroy bacteria, Nature's counterpoise against epidemics. Science has now to face a new and important problem. How can we utilize the diseases of bacteria as a defence against them?

BACTERIOLOGISTS the world over are now considerably interested in a quite new phenomenon in the life of bacteria, the so-called "d'Herelle's phenomenon."

In 1917 Dr. F. d'Herelle of the Pasteur Institute, brought before the French Academy strong experimental evidence that bacteria, themselves parasites upon higher organisms, in their turn have parasites that destroy them.

His observations and the "vital" theory by which he explained them, appeared to many bacteriologists to be too sensational, too extraordinary, even to be inconsistent with the laws of nature. But let us look at this theory from the simplest, most commonsense point of view. We readily admit that every organism which can be seen by the naked eye has its diseases, every plant has them. These diseases are chiefly of bacterial or ultrabacterial origin, and we know of severe epidemics which may destroy locally an entire species. We are familiar with a number of parasites that live upon parasites, for example, the ticks of the flea, and the possibility of infectious diseases of these ticks would be readily admitted. Why then should micro-organisms have the privilege of being free from them, of being the sole organisms to die from the "natural death" of senility or from physical causes? Such a view seems illogical and, with d'Herelle, we accept the possibility of the existence of infectious diseases among micro-organisms.

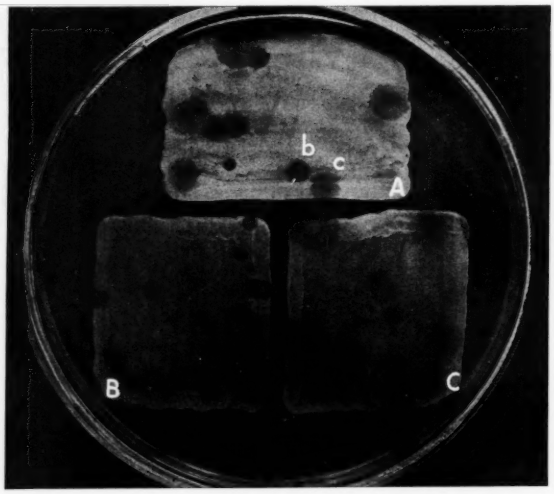

FIG. 1.—A, b and c ON UPPER CULTURE ARE GROWTHS OF MIXED BACTERIOPHAGES.
B and C ON LOWER CULTURES SHOW THE SEPARATED COLONIES OF DISTINCT BACTERIOPHAGES.

Experiments.

The proofs that d'Herelle gives are purely experimental, and the logic of his experiments and their ingenious simplicity are very striking. His fundamental experiments, which have been confirmed by all who repeated them, are as follows:

A small quantity of the excreta of a patient convalescent from typhoid fever or dysentrey is mixed with a suitable nutrient medium, such as sterile broth, and kept at body temperature in an incubator. At the end of twenty-four hours the previously clear broth will have become turbid owing to the growth of bacteria in it. The broth is now filtered through a porcelain filter, which strains off all the bacteria, and a trace of the clear fluid is added to a fresh tube of broth in which is growing a pure culture of the bacteria that caused the patient's disease. This tube is placed in the incubator. After a few hours it becomes quite clear and all the bacteria in it are found to have been dissolved. A trace of the fluid from this tube is added to another containing living bacteria, and again they are found to be dissolved after a few hours, and the experiment may be continued indefinitely. From this experiment we see that the excreta of a convalescent patient contain something that destroys bacteria, and that this "something" regenerates itself while destroying them. We can learn more about it by repeating the experiment in a slightly different way, as follows:

A small quantity of fluid containing the bacteria that caused the patient's illness is spread over the surface of a nutrient jelly made of broth, solidified with a kind of vegetable gelatine prepared from a Japanese sea-weed. After twenty-four hours, each bacterium deposited on the surface of the jelly will have multiplied

into a colony, appearing to the naked eye as a small, slightly opaque patch. On further incubation the colonies enlarge until, finally, they coalesce and the whole surface of the jelly is covered with a film of bacteria. This process is now repeated, using a fluid containing a considerable number of bacteria, so that a film will be rapidly formed, but with it is mixed a trace of liquid containing the "something" that destroys bacteria. After twenty-four hours we notice a curious change in the growth of the bacteria, for the film, instead of being uniform, is dotted with a number of clear circular areas in which no living bacteria can be found. These clear areas gradually enlarge until they coalesce and all the bacteria on the surface of the jelly are destroyed. If a platinum needle be rubbed over the surface of one of these clear areas, and then washed in a broth culture of the appropriate bacteria, it is found that the culture begins to become clear and eventually all the bacteria in it are destroyed.

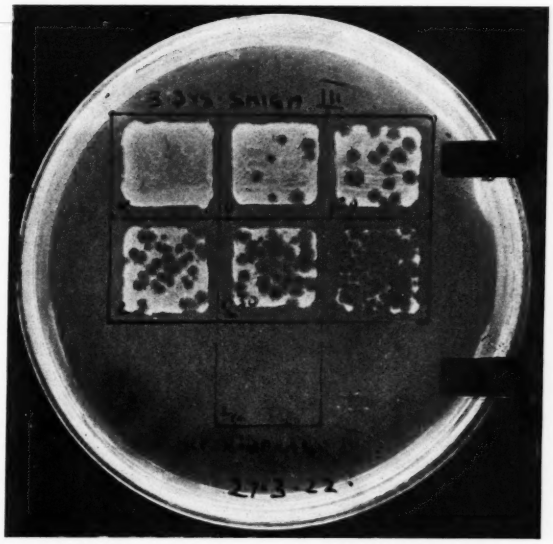

FIG. 2.
K. CONTROL, NORMAL EMULSION WITHOUT BACTERIOPHAGE.
O. EMULSION IMMEDIATELY AFTER INOCULATION WITH BACTERIOPHAGE.
THE REMAINING CULTURES SHOW THE DEVELOPMENT IN PROCESS OF TIME.

Lysin or Parasites.

We conclude that the clear areas in the last experiment are the places where the "substance" that dissolves bacteria has settled and multiplied while destroying the bacteria in its neighbourhood. It has been shown that this substance is not in solution, but exists as minute particles, invisible even under the highest magnifications that we can command, but calculated to have a diameter of approximately 20$\mu\mu$*; they are, therefore, not infinitesimally small, but bear about the same relation to the bacterium as a large fly does to an ox. It is noteworthy that these clear areas bear a striking resemblance to colonies of bacteria and, in fact, they are considered by the followers of d'Herelle's theory to be colonies of the parasite of bacteria, the Bacteriophage.

The vital, that is, the parasitic nature of this phenomenon is not yet universally accepted, and a controversy, like that held by Pasteur with the defenders of the non-vital theory of fermentation and infectious diseases, is still in progress. It is said by those who do not hold d'Herelle's theory that the transmissible lysin (the substance that causes the bacteria to dissolve) is not a living organism, but is a substance produced by the bacteria themselves. Under the influence of this substance the bacteria dissolve and, as a result of their breakdown, a new quantity of the lytic substance is produced. Once this process has started (under conditions that are not precisely defined) it spreads from one bacterium to another and so may be transmitted indefinitely. But the facts gathered together and taken as a whole speak in favour of the vital theory of d'Herelle. I will mention only a few of them.

New Strains.

At the present time an enormous number of different strains of Bacteriophage have been isolated. Bacteriophages have been found against almost every type of simple bacteria, and, what is very important, every strain presents some particularities that distinguish it from the others. There are Bacteriophages that act on one species of bacteria only, and some of them limit their action to one particular strain of one species. We can also isolate many different Bacteriophages which act, though in different ways, on one and the same strain of bacteria. Thus we have a strain of Bacteriophage which acts very slowly on the dysentery bacillus, giving small and discrete clearings in the film of bacteria on the solid medium, another destroys the same bacteria very quickly and gives large clearings, a third one, also very energetic, gives large clearings, but of quite different appearance. If these three strains of Bacteriophage are mixed and sown with the dysentery bacillus on the surface of the nutrient jelly, the resulting film will show three different kinds of clearings from which the three different strains of Bacteriophage may be isolated. We can

*$\mu\mu$ = micromicron or millicron.

repeat this experiment with three, five or even ten different Bacteriophages with the same result, and it is difficult to believe that one species of bacteria could produce so many different autolytic substances.

An acid reaction of the nutrient medium inhibits the development of the Bacteriophage, but if we gradually increase the acidity of the medium, we can accustom the Bacteriophage to grow and to destroy bacteria in an acid medium. Using the same method of gradual change we can accustom the Bacteriophage to the poisonous action of glycerine etc., we can also accustom the Bacteriophage to destroy and live upon bacteria which it could not previously attack. It is clear that only a living organism, and not a non-vital substance, can be adaptable.

Rival Bacteria.

The adaptability of the parasite will explain the role that it plays in human life. Many experiments have shown that the Bacteriophage, one or another kind of it, can be found almost everywhere: in the intestinal canal of a great majority of men and animals, in water, soil, etc. It lives there at the expense of the bacteria present; thus, in the human intestine, it lives on the bacillus coli that is always present there. Suppose, now, that a man contracts typhoid fever, the typhoid bacillus begins to multiply in the intestine and greatly inhibits the growth of the bacillus coli. Thanks to its adaptability, the Bacteriophage of bacillus coli begins to acquire the faculty of using the typhoid bacillus as its food. There now begins in the intestine a struggle between Bacteriophage and bacillus, and the course of the illness is a reflection of this conflict. If the conditions are favourable to the bacteria, there is an aggravation of the disease; if the Bacteriophage acquires the necessary activity, then convalescence begins. Other factors, however, play a part, and the course of the disease is very complicated.

The reader will naturally ask: "Then it is only necessary to find a sufficiently potent Bacteriophage for every disease and humanity will be for ever saved from infectious diseases, as all the dangerous bacteria will be destroyed by the appropriate Bacteriophages?" But Nature is not so simple, nor the bacteria so powerless. Even in the greatest epidemics the whole population cannot be destroyed, for there are always individuals who are resistant to the infection and survive, so in an epidemic among the bacteria themselves there will always be some resistant individuals who escape the action of the Bacteriophage, and, multiplying, give rise to an immune strain of bacteria even more dangerous to man than were their ancestors. We are not yet sufficiently acquainted with the biology of the Bacteriophage to make free practical use of it without the risk of injuring instead of helping.

Veterinary Applications.

Still, experiments in its practical application are very encouraging, and give us hope that the Bacteriophage, in the near future, will play an important part in combating infectious diseases. Dr. d'Herelle carried out some experiments during an epidemic of fowl typhoid, a very severe contagious disease, fatal to more than 95 per cent. of the birds infected. The experiments were carried out over a large area containing many poultry farms, and many thousands of birds, and at a time when the epidemic was in full development and many farms had already lost 20 to 25 per cent. of their birds. In this area 25 poultry yards, containing 2,100 birds, were chosen at random and every bird, whether infected or not, received 0.5cc. of a liquid containing the Bacteriophage acting on the bacillus of fowl typhoid. From the day of its administration no more new cases occurred, while the mortality in those already attacked fell to 5 per cent. In the other poultry yards, that were left untreated as a control, the disease continued to progress as before.

Another experiment was carried out with *barbone*, a still more fatal disease that attacks buffaloes, and, as a rule, kills every animal that contracts it. One quarter of a cubic centimetre was found to be sufficient to make the animal resistant to a dose of bacteria one thousand times greater than the minimum fatal dose.

Successful Results.

In a few cases of human dysentery where the use of the Bacteriophage was tried, the diarrhoea ceased within thirty-six hours of the administration of the Bacteriophage, and no more dysentery bacteria were found in the excreta.

Such is the phenomenon discovered by d'Herelle, and many bacteriologists in many parts of the world are investigating it; some are trying to obtain decisive evidence of its vital or non-vital character, others are studying it as a biological problem, and, whether it prove to be a vital or a non-vital phenomenon, we have good reason to hope that in a few years we shall have in our hands a powerful weapon against infectious diseases. Already we have a new field of Science—the infectious diseases of bacteria.

Crystals Which Talk.

THERE are certain crystals which have nothing whatever to do with the "crystals" used in wireless receivers which are yet capable of transmitting speech. They are easy to produce and offer an excellent field for simple experiment and original research.

It has long been known that certain crystals, when submitted to pressure or strain, possessed the property of generating a small but steady current of electricity so to speak on their own account. This form of electricity is known as piezo-electricity, and, though the actual flow of current is very small, it is in the case of a large crystal capable of working several high resistance telephones. The fluctuations in the current generated vary directly with the stresses applied to the crystal, and it is possible that this property will find a commercial application in connection with amplifiers for use in wireless.

Common "Rochelle salt," a bi-tartrate of potassium which can be obtained from any chemist's shop, is the best of these particular crystals yet known. It is readily soluble in water and crystallizes rapidly from a saturated solution. An ounce or two of powdered Rochelle salt should be dissolved in warm water and set aside for forty-eight hours, when a deposit of small crystals will be found. These should be carefully taken out of the solution and dried. They should then be carefully picked over and a dozen, not necessarily the largest, but the most perfectly formed selected and set aside.

The solution is again heated and the unselected crystals returned to it and redissolved. When this is cold the chosen crystals are returned to it and again left for twenty-four hours. They may, if large enough, be suspended in the solution by loops of silk, but, in any case, such is the contrariness of crystals, that only a few out of the whole will develop into perfect crystals. As soon as it can be seen which ones are growing properly the inferior specimens which have developed into groups or clusters of crystals should be removed.

With care, crystals up to an inch and a half long can be grown in a week. Big perfect specimens may take months to grow, and monster crystals have been produced under laboratory conditions.

When the crystal is large enough it must be cleared of surplus water by drying it in 90° alcohol for at least twenty-four hours. It is then able to stand baking at 40° C for several days.

Thus prepared, the electrical contacts are applied in the shape of a cap of copper foil at one pole and a copper foil band secured around the middle of the crystal. Experiment proves that all stresses set up a flow of electrical energy from the crystal, but that a twisting effect applied about the principal axis develops the maximum output.

A crystal thus prepared and fitted with a needle attachment so that it can be used on a gramophone record in place of a sound-box and tone-arm will act as a transmitter of speech or music from the record, and will operate several pairs of telephones perfectly. In the same way a crystal clamped between a rigid support and a diaphragm capable of responding to voice or musical vibrations will transmit electrical impulses over a long circuit and act as a "batteryless" telephone.

Books Received.

Elementary Applied Mechanics. By T. ALEXANDER C.E., M.Inst., C.E.I. and A. W. THOMSON, D.Sc. (Macmillan & Co. 15*s.* net).

Applied Chemistry. IRA D. GARARD, Ph.D. (Macmillan & Co. 15*s.* net).

An Introduction to the Study of Cytology. L. DONCASTER. Second Edition. (Cambridge University Press. 21*s.* net).

The Mechanism of the Cochlea. GEORGE WILKINSON and ALBERT A. GRAY. (Macmillan & Co. 12*s.* 6*d.* net).

Wireless Possibilities. PROF. A. M. LOW. (Paul Kegan. 2*s.* 6*d.* net).

The Nature of Intelligence. L. L. THURSTONE. (Kegan Paul. 10*s.* 6*d.* net).

Alone in the Sleeping Sickness Country. FELIX OSWALD, D.Sc., F.G.S., F.R.G.S. (Kegan Paul. 6*s.* net).

Kant's Treatment of Causality. A. C. EWING, D.Phil. (Paul Kegan. 10*s.* 6*d.* net).

Science Progress. Vol. XIX, No. 73, July 1924. (John Murray. 6*s.* net).

Matter and Change. W. E. D. WHETHAM. (Cambridge University Press. 7*s.* 6*d.* net).

The Earth. By H. JEFFREYS. (Cambridge University Press. 16*s.* net).

Masters of Science and Invention. By FLOYD L. DARROW. (Chapman & Hall. 10*s.* 6*d.* net).

VIIth International Congress of Psychology. By CHAS. S. MYERS. (Cambridge University Press. 12*s.* net).

Whitby Abbey. By PETER HOOD. (Hood & Co., Ltd. 1*s.* 6*d.* net).

The National Physical Laboratory Report for the Year 1923. (H.M. Stationery Office. 13*s.* 6*d.* net).

Growth. By G. R. DE BEER, B.A. (Ed. Arnold & Co. 7*s.* 6*d.* net).

Geographic Journal. (Royal Geographical Society. 2*s.* net).

Atoms and Rays. By SIR OLIVER LODGE, F.R.S. (Ernest Benn, Ltd. 21*s.* net).

Book Reviews.

Animal Parasites and Human Disease. By Asa C. Chandler, M.S., Ph.D. Second Edition, revised. (London: Chapman & Hall Limited. 22s. net).

Dr. Asa C. Chandler has issued a second edition of this admirable textbook "Animal Parasites and Human Disease." Dr. Chandler is instructor in Biology at the Rice Institute at Houston, Texas; and all those who know the Rice Institute will feel that the book is fully worthy of its place of origin.

One-third of the book is rightly occupied with parasitic protozoa whose effect on the health of our animals is becoming increasingly evident. The style of the author is simple, and, although we may regret the American spelling of certain words, there are very few oddities in the diction. Each parasite is concisely described, its life-history recorded in detail, and methods of combating it are given. As an example of the author's writing we may quote the following paragraph on "specifics":—

> One of the first specific drugs known was quinine for malaria. The use of cinchona bark, from which quinine in its various forms is manufactured, is said to have originated with the Indians of Ecuador, and to have been introduced into Europe by Spaniards in 1642. The sulphate of quinine, which is the form of the drug in commonest use now, was first used in 1840. In 1880 Bozzolo, an Italian, first introduced thymol as a remedy for intestinal worms, especially hookworm, and this has been considered a standard and almost specific cure for hookworm until within the last two years, when oil of Chenopodium has been substituted for it to a large extent. The next specific drug of great importance to be discovered was salvarsan for spirochaetes, discovered by Ehrlich in 1905. In the same year atoxyl, one of the most efficient remedies yet discovered for trypanosome diseases, was discovered by Thomas. Emetin was discovered to be a specific remedy for amebic dysentery by Rogers in 1913 as the result of Vedder's work with ipecac, from which emetin is manufactured. In 1914 tartar emetic, previously used as an alternative for arsenic compounds (chiefly atoxyl) against trypanosomes, was discovered by Vianna to be a wonderfully efficient specific remedy for the severe South American leishmaniasis, and was subsequently found to be specific for all *Leishmania* diseases.

There is an excellent account of Land Leeches, which make such havoc throughout south-eastern Europe, Australia and in the Andes. These terrible pests render it impossible to keep cattle in many of the lower ranges of the Himalayas, for they get into their nostrils and their throats and cause persistent haemorrhage. During droughts the leeches, which exist in millions of millions in damp places, entirely disappear, and, after even the shortest shower of rain, quite suddenly reappear. It would be of great interest if dwellers in the infested regions would find out what becomes of them when the land dries up.

The last quarter of the book deals with fly-borne diseases and the control of the fly, tick, mosquito and mite. There is a particularly good account of the Yellow Fever Mosquito, which the author calls *Aedes calopus*, thus replacing the much more familiar name of *Stegomyaa fasciatus*, whose habits are detailed as follows:

> The yellow fever mosquito is the most thoroughly "domesticated" species known. It is seldom found except in the vicinity of houses and shows a decided preference for human blood. As a rule it seldom leaves the rooms of houses except to find a suitable place to lay its eggs. Long familiarity with man has made this mosquito one of the most elusive and well-adapted pests of the human race which nature has ever evolved. Its stealthy attack from behind; its habit of crawling up under the clothing to bite in preference to attacking the exposed ankles; the suppression of the characteristic mosquito "song," so that its bite comes suddenly and without warning; its habit of concealing itself in pockets, folds, etc., of garments; its hiding behind pictures, under chairs, etc.; the wariness of its larvae;—all these are the result of lessons learned from long and close association with man.
>
> *Aedes calopus* is principally a diurnal mosquito, and becomes particularly hungry in the early morning and during the afternoon. It will bite in lighted rooms, but will never bite in the dark. The French Yellow Fever Commission in Rio de Janeiro stated that *Aedes calopus* is nocturnal The evidence for this conclusion, which is at variance with the observations of other workers, has been shown by Howard, Dyar and Knab to be very inadequate and faulty. The danger of sleeping in an infected place, and the comparative freedom from danger enjoyed by persons who visit infected places only in the daytime, is thought to be due to the fact that most of the mosquitoes obtain a meal very early in the morning, just after daybreak.

The book is well illustrated and there is a good index. The proof-reading however, might have been better, and there are some curious errors in composition, But it is poor work pecking at spots in the sun.

Kitab Al'ilm Al-Muktasab Fi Zira'at Adh-Dhahad: Book of knowledge concerning the cultivation of Gold. By Abu'l Qasm Muhammad Ibn Ahmad Al'Iraqi. The Arabic Text edited with a translation and introduction by E. J. Holmyard. (Paul Geuthner, Par. 3).

This book, which will be of great interest to students of the history of Science, is a translation of an Arabic work of the thirteenth century, dealing with the preparation of the Elixir and the transmutation of metals.

The Arabs have long been known as the originators of much of our chemical knowledge, and perhaps have overshadowed the late Greek alchemists of whom the first experimental chemisty is recorded. In spite of the reputation of Arabic Science, few have had the opportunity to read the original texts, for chemists are rarely orientalists and very few of these texts have been translated. The problem of the origin of Alchemy is a difficult one. The earliest Greek writings which can be called alchemical, refer the source of their traditions to Egypt and Persia, but the assertions of such windy mystics as the "Pseudo-Democritus" and Zosimus must be regarded with some susdicion. The Arabic tradition probably followed on from the Greek, though there may have been an independant Eastern tradition from which both were derived.

Al-Ivagi mentions Greek authors and makes reference both to real personages such as Theodorus and Ostanes and such doubtful figures as Agathodemon, the Gnostic angel of God, and Hermes Trismegistus. The theories he expounds may be found half developed in the Greek alchemical works, but a great change has taken place. The habit of thought of the late Greek, permeated with the most corrupt and credulous forms of mysticism, was little adapted to the foundation of a Science. The Arab developed a love of scientific knowledge which overmastered the destructive classical tendency to theorise on an absurdly small basis of ascertained fact.

Our author expounds his theories clearly and concisely. The metals known to him were gold, silver, copper, iron, lead, and

tin. He believed all these to be varieties of the same species. All of these metals, save only gold, had accidental properties, the removal of which would convert them into gold, which potentially they were. As Al'Ivagi says " And these six forms of a single species are similar merely to health and disease in a man. When the fever is treated, it departs and the man returns to freedom from disease, he regains the most perfect state of health."

How were these metals to be brought to perfection? Their faults were excess of hotness or coldness, iron and copper being hotter than gold, and the remaining metals colder. The plan of the alchemist was to prepare a compound which would supply the lacking properties, and neutralise the superfluous ones. Gold would not do this, as it had no excess of its own properties. But, he believes, if gold was fed with a certain mysterious food, it would grow and develop more of its properties so that it could impart them to other metals.

The great secret was the nature of the prime matter. The Arab and mediaeval alchemists describe the process in great detail, but one and all keep the prime matter secret or reveal it only in unintelligible allegory. The Al'Muktasab, though singularly free from turgid allegorical passages, takes refuge in comparing the prime matter to raging lions, rocky mountains, and other picturesque objects.

" And this prime matter is found in the cold peninsular of Andalusia, on the shores of the ocean wherein are the caverns of Al-Astiyusia. And it is often found in a mountain in the land of India, in rocks diverse in colour and taste and smell and properties. Among them is a rock in which a devouring lion takes shelter and often he defends it. And the top of the rock is confused with its base, and its nearest part reaches to its farthest, and its head is in the place of its back and vice versa."

These allegories are almost impossible to interpret, but a certain amount of information has been gathered as to the usual practical procedure.

Acids and caustic alkalies were little used. The favourite method of attacking metals was the use of solutions of poly-sulphides of calcium known as Water of Sulphur or Divine Water. Amalgamation and distillation were much practised.

Mr. Holmyard in his interesting introduction provides a list of reagents, known to the Arabs, which may give us an idea of the products they could obtain. In spite of this knowledge of the substances used, it is often difficult to interpret the results they obtained. Mr. Holmyard also gives some details of chemical manipulation as practised by the Arabs, which will be found of much interest. He tells us that he has reserved his consideration of the theory and practice of Arabic alchemy for a later volume.

The appearance of this will be awaited with interest, and will add much to the value of the work now under consideration.

Medicine, Magic and Religion. By W. H. RIVERS, M.D., D.Sc., LL.D., F.R.C.P., F.R.S. (Kegan Paul, 10*s.* 6*d.* net).

The lectures of which this book is made up were delivered, with one exception, between 1915 and 1916, and Dr. Rivers had intended that they should form the skeleton of a comprehensive work on Primitive Medicine, upon which he was working up to the time of his early death, which was to prove so great a loss to British psychology and ethnology. Although a great deal of material had been accumulated for the projected work, Prof. Elliot Smith, who contributes a short preface, has wisely published the lectures as they were originally issued.

The first part of the book is a study, at first hand, of the practice of medicine, and its relation to magic and religion in Melanesia and New Guinea. Dr. Rivers separates domestic medicine from professional medicine, using the old comprehensive but exact word " leechcraft " to cover the practice in both cases. About professional leechcraft in the group that he selected for study, he comes to the very definite conclusion that the " modes of treatment follow directly from their ideas concerning etiology and pathology. From our modern standpoint we are able to see that these ideas are wrong. But the important point is that, however wrong may be the beliefs of the Papuan and Melanesian concerning the causation of disease, their practices are the logical consequence of those beliefs." This conclusion is important because it is indirectly opposed to a theory of a French school of ethnology which holds that primitive man has not yet reached a logical stage of thought.

Domestic leechcraft - that is, the treatment by household remedies of minor ailments that do not call for the services of the doctor—was placed in a separate category because, unlike professional leechcraft, it was not found to be directed by any ideas concerning the causation of disease, nor was it blended either with magic or religious practices.

The second part of the book is even more important, for in discussing the evolution of leechcraft Dr. Rivers questions the validity of the current theory that similar rites and practices occurring in different parts of the world are of independent origin, and owe their similarity to a tendency of the human mind to react in a uniform way to its social and physical environment. In place of this theory, Dr. Rivers revives the pre-evolutionary idea of the direct transmission of culture and beliefs by the migration of races and by hostile and trading expeditions. This theory implies that many practices, hitherto regarded as primitive, may be, in reality, the result of degeneration. For example, a purely hygienic practice may be introduced from another race and adopted as a religious ceremony, or a materially minded people may borrow a religious rite whose practical value appeals to them and employ it without any religious motive.

The inception of this theory is claimed to mark almost a new era in ethnology. The general idea of social evolution still holds good, but it loses its old architectural simplicity, and for the followers of the new school a wide field of research is opened up in tracing the transmission of various rites and practices, and in studying the changes that they have undergone in their wanderings.

As a kind of appendix to the book, Prof. Elliot Smith has included a separate lecture on " Mind and Medicine," in which Dr. Rivers traces the evolution of psychological treatment, pointing out the change that has taken place in our attitude towards the mental factors in disease and the extension of the scope of treatment that is the result of a new line of approach. This last lecture is complementary to the rest of the book, in tracing out a certain measure of return to the old co-operation between medicine and religion in the similarity of the methods employed by priest and physician in the treatment of similar troubles and disorders.

Any work by Dr. Rivers will be read by the specialist, but the present book, with its broad treatment of the subject matter and simple exposition, should make a wide appeal to the general reader.

F. A. H.

The Foundations of Einstein's Theory of Gravitation. By ERWIN FREUNDLICH. Second English Edition, translated from the Fourth German Edition by H. L. BROSE, with an introduction by Professor H. H. TURNER, xiv.+140 pp. (London: Methuen & Co., 1924).

The Theory of Relativity: Three Lectures for Chemists. By ERWIN FREUNDLICH, translated by H. L. BROSE, with an introduction by Viscount HALDANE, xii.+98 pp. (London: Methuen & Co., 1924).

It is not an easy task to describe the fundamental principles of the theory of Relativity in non-technical language, for many of the ideas involved in its development, such as those of a continuum or an invariant, though familiar to the mathematician, have not yet obtained a place among popular conceptions. There is thus a temptation, in writing a book for the lay reader, to emphasise the more startling of the consequences of Relativity at the expense of the more fundamental argument. In the two books under review, Dr. Freundlich attempts to overcome this difficulty, and with a considerable measure of success. In each book he discusses first in what respects the Galilei-Newton system of mechanics fails to accord with observed physical fact. He then develops in turn the restricted and the general theory of Relativity, showing how the first is demanded by the observed constancy of the velocity of light under all conditions of uniform motion, and the second by the absolute equality of the inertial and gravitational masses of matter. The account is throughout logical and lucid, though possibly in the first book the unduly repeated emphasis upon certain steps in the argument diminishes rather than increases the clarity of the exposition. The mathematics are nowhere other than elementary, and in the "Lectures to Chemists" almost non-existent. Both books, and especially the latter, are to be recommended to the non-mathematician interested in Relativity.

D. C. H.

Report on Radiation and the Quantum Theory. By J. H. JEANS. Second Edition, 86 pp. (The Physical Society of London. 1924. 7*s.* 6*d.* net).

Though Professor Jeans' report is no doubt primarily designed to meet the needs of the serious student of the quantum theory, who is prepared to face the mathematical reasoning involved, it makes a strong appeal to those who, like the reviewer, are mainly interested in the physical interpretations of the theory. The author has deliberately arranged his material so that it is possible to pass over the more mathematical parts, and the reader who does so will obtain nevertheless a clear and logical account of the reasons which have necessitated the abandonment of classical mechanics as applied to atomic phenomena; of the main steps in the development and verification of the quantum theory; and of the possibilities of reconciling the latter with the demands of the wave theory of radiation.

According to modern conceptions, radiation is propagated in regions free from matter in full accord with Maxwell's laws; it is matter which introduces the anomalies by being incapable of accepting or delivering energy except in quanta. "We no longer think of a spherical wave as carrying with it a store of energy in each element of its wave-front, to be yielded up to whatever matter it encounters; we rather think of it as carrying with it a potentiality of yielding up energy to such matter as it encounters in a suitable state to receive this energy. The amount of energy which it may yield up remains always equal to $h\nu$, but the chance of its yielding this amount up falls off as $1/r^2$. The total 'expectation' of the energy to be yielded up by the whole wave-front, of area $4\pi r^2$, is accordingly independent of r. The conservation of energy now reappears, but merely as a statistical law, which is not necessarily true in every individual case, but has the same probability of truth as, for instance, the second law of thermodynamics."

D. C. H.

An Introduction to the Study of Cytology. By L. DONCASTER. Second Edition. (Cambridge University Press. 21*s.* net).

The new edition of this valuable work is certain of a genuine welcome, for it is not merely a textbook but a very comprehensive survey of a most important subject. Cytology, the science of cells, is the very foundation of biological study, and to it we owe the increasing light directed on the subjects of sex determination and inherited characteristics.

Those readers of DISCOVERY who have followed the recent series of articles by Doctor Hogben, will find this book both useful and interesting. It is obviously rather beyond the general reader, but it can be cordially recommended to the student who is entering on a course of biological research in any branch.

Professor Doncaster died shortly after the publication of the first edition, and this second edition has been slightly amended and new facts determined since have been incorporated. The book gives a complete introduction to cell study and passes rapidly to chapters on Fertilization, Parthenogenesis natural and artificial, Sex-determination, and the methods of investigation of the origin of life. It includes an admirable bibliography.

Evolution at the Crossways. By H. REINHEIMER. (C. W. Daniel. 6*s.* net).

Mr. Reinheimer has a missionary belief in symbiosis as the equivalent of a natural moral law. He backs the theory of co-operation in nature and contends that the doctrine of the predatory aspect of nature is wrong. Without a morality of some kind every species is eventually doomed to self-destruction.

Without necessarily agreeing with him in his wide-sweeping claims, one can yet say that he suggests a new idea which is open to a good deal of speculation.

It is a bold attempt to reconcile the moral values associated with religion and philosophy with the facts as determined by biology and he shows a clear appreciation of biological progress. Like all pleaders he stresses only his own side of the case, that is to say, that effective sound and normal evolutionary progress is associated with co-operation in nature—symbiosis. Predatory and parasitic species are in essence abnormal or evil, and are evolutionarily speaking doomed.

It is an idea that cannot be casually dismissed, and he argues well and vigorously, appealing both to the sociologist and the biologist, who will at least have to take his suggestions into account.

The Depths of the Universe. By GEORGE ELLERY HALE. (Chas. Scribner's Sons. 7*s.* 6*d.* net).

Good authoritative popular essays on astronomical subjects. Well illustrated and written by an expert for the general reader. The subjects covered are the Depths of the Universe now disclosed by the latest telescopes, Barnard's Dark Nebulae, and Sunspots as magnets—three long articles or short essays which are excellent.

The author still clings to the old idea which held up Galileo as in serious danger of the stake. More careful and less sectarian research shows Galileo as an acid controversialist, and the action of the Church to have been astonishingly amiable for the period. Painstaking and intellectual Cardinals did their best to persuade Galileo to drop in a "perhaps" or an "in all probability" as a concession to the powers that were, and in the end, when the Church fanatics forced the Church to take action, it was about the mildest kind of action.